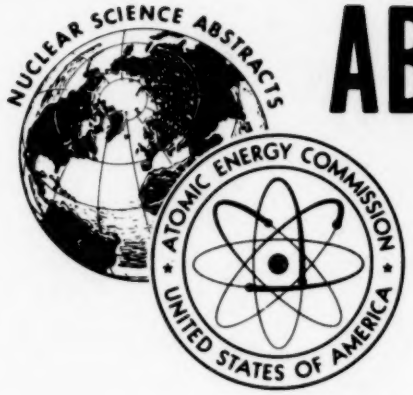
NUCLEAR SCIENCE ABSTRACTS



Volume 29 Number 4

Abstracts 7481-9723

February 28, 1974

UNITED STATES ATOMIC ENERGY COMMISSION

REPORT COLLECTIONS IN THE UNITED STATES

The libraries listed below purchase and maintain microfiche collections of USAEC and foreign reports that are abstracted in *NSA*. Their collections also include *NSA* and its indexes, AEC's Technical Progress Reviews, AEC-sponsored translations, conference proceedings published by AEC, and various bibliographic tools. Most of these libraries have microfiche reader-printers or other photocopy facilities with which to reproduce enlarged copies from microfiche. Charges for reproduction services vary.

Report collections of USAEC reports in countries other than the United States are listed on the inside back cover.

ALABAMA
Auburn, Auburn University
Tuskegee Institute, Tuskegee Institute

ALASKA
College, University of Alaska

ARIZONA
Tucson, University of Arizona

CALIFORNIA
Davis, University of California
Los Angeles, University of California
Santa Barbara, University of California

COLORADO
Boulder, University of Colorado

DISTRICT OF COLUMBIA
Washington, Library of Congress

FLORIDA
Gainesville, University of Florida

GEORGIA
Atlanta, Georgia Institute of Technology

HAWAII
Honolulu, University of Hawaii

IDAHO
Pocatello, Idaho State University

ILLINOIS
Urbana, University of Illinois

INDIANA
Lafayette, Purdue University

IOWA
Ames, Iowa State University

KANSAS
Manhattan, Kansas State University

KENTUCKY
Lexington, University of Kentucky

MARYLAND
Baltimore, Johns Hopkins University
College Park, University of Maryland

MASSACHUSETTS
Cambridge, Massachusetts Institute of Technology
Worcester, Worcester Polytechnic Institute

MICHIGAN
Ann Arbor, University of Michigan

MISSISSIPPI
State College, Mississippi State University

MISSOURI
Columbia, University of Missouri
Kansas City, Linda Hall Library

NEW JERSEY
Princeton, Princeton University

NEW MEXICO
Albuquerque, University of New Mexico

NEW YORK
Albany, New York State Library
Albany, State University at Albany
Ithaca, Cornell University
New York, Columbia University
Rochester, University of Rochester
Syracuse, Syracuse University
Troy, Rensselaer Polytechnic Institute

NORTH CAROLINA
Raleigh, North Carolina State University

OHIO
Cincinnati, University of Cincinnati
Cleveland, Cleveland Public Library

OHIO (Continued)
Columbus, Ohio State University
Toledo, University of Toledo

OKLAHOMA
Norman, University of Oklahoma

PENNSYLVANIA
Philadelphia, University of Pennsylvania
Pittsburgh, Carnegie Library
University Park, Pennsylvania State University

PUERTO RICO
San Juan, University of Puerto Rico

SOUTH CAROLINA
Columbia, University of South Carolina

TENNESSEE
Knoxville, University of Tennessee

TEXAS
Austin, University of Texas
College Station, Texas A & M University
Houston, Rice University

UTAH
Salt Lake City, University of Utah

VIRGINIA
Blacksburg, Virginia Polytechnic Institute
Charlottesville, University of Virginia

WASHINGTON
Pullman, Washington State University
Seattle, University of Washington

WEST VIRGINIA
Morgantown, West Virginia University

WISCONSIN
Madison, University of Wisconsin

USAEC reports so indicated in *Nuclear Science Abstracts* are offered for sale by National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22151.

Volume 29, Number 4, February 28, 1974

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Office of Information Services, John A. Harris, Director.
Published by the USAEC Technical Information Center, Robert L. Shannon, Manager.

Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the USAEC Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

Atomic Energy of Canada Limited
Australian Atomic Energy Commission
Danish Atomic Energy Commission
Finnish Atomic Energy Commission
French Atomic Energy Commission
Japan Atomic Energy Bureau–Atomic Energy Research Institute
Institutt for Atomenergi (Norway)
Aktiebolaget Atomenergi (Sweden)
United Kingdom Atomic Energy Authority
Zentralstelle für Atomkernenergie-Dokumentation (West Germany)

Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

HOW TO OBTAIN NUCLEAR SCIENCE ABSTRACTS

Nuclear Science Abstracts is available to the public on a subscription basis from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

NSA is issued in two volumes per calendar year, one beginning January 15, the other July 15. Each volume consists of twelve issues.

For the two 12-issue volumes, the annual subscription rate is $75.50 for domestic subscribers and $94.50 for foreign subscribers. A single issue costs $3.25 domestic rates or $4.07 foreign rates. Domestic rates apply to the United States, Canada, Mexico, and Central and South American countries except Argentina, Brazil, Guyana, French Guiana, Surinam, and British Honduras.

Indexes are cumulated for each volume, i.e., on a six-month volume basis. Each volume index is priced at $35.70 for domestic subscribers and $45.10 for foreign subscribers.

Previous *NSA* cumulative indexes are available:

From Johnson Reprint Corporation, 111 Fifth Avenue, New York, N. Y. 10003:
Vols. 1–4, Subjects and Authors (1948–1950), $30.00.

From Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830:
Vols. 5–10, Subjects and Authors (1951–1956), $5.25.
Vols. 11–15, Subjects (1957–1961), $19.00.
Vols. 11–15, Personal Authors (1957–1961), $14.25.
Vols. 11–15, Corporate Authors (1957–1961), $2.50.

From Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402:
Vols. 16–20, Subjects (1962–1966), $36.00.
Vols. 16–20, Personal Authors (1962–1966), $22.50.
Vols. 16–20, Corporate Authors (1962–1966), $3.75.
Vol. 26, Subjects and Authors (1972), $37.75.
Cumulative Report Number Index, Vols. 1–15 Revised, $4.00.
Cumulative Report Number Index, Vols. 16–20 Revised, $5.50.
Cumulative Report Number Index, Vols. 21–26, $9.00.

From Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106:
Vols. 21–25, Subjects, Authors, and Corporate Authors (1967–1971), $195.00.

Nuclear Science Abstracts is available on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information. Government agencies may obtain *NSA* free of charge. Inquiries should be directed to the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Nuclear Science Abstracts is also available on 16-mm and 35-mm microfilm in reel or cartridge from Princeton Microfilm Corporation, Alexander Road, Princeton, New Jersey 08540. The cost of Vols. 1–26 (1948–1972) including *Abstracts of Declassified Documents* (1947–1948) is $730.00. The indexes for *Nuclear Science Abstracts* Vols. 1–26 (1948–1972) are also available for $385.00. The cost of each volume (six months) of *NSA* and its indexes is $45.

INDEXES TO NSA

Comprehensive indexes appear in each issue and are cumulated at the end of each volume. The report number indexes will be cumulated on both a volume and two-volume basis. Multi-volume cumulations have been issued as indicated above.

All documents abstracted are indexed by subjects and personal authors. Report literature is indexed also by corporate author and report number. Each of these indexes in every issue is preceded by an introduction explaining in detail the organization of the index and the principles by which it is compiled. The reader is referred to these explanations for information not found in the brief summaries below.

Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

COX, S.H, DNA replication of induced prophage in Haemophilus influenzae, 28:18453
CRANDALL, J.L, Californium-252 neutron sources, 28:18415 (DP-MS-72-45)
CRAWFORD, J.F, Electron multiplication in cavities, 28:18990

Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

REACTORS/RESEARCH PROGRAMS
Institute of Nuclear Research two-year-book, 1970--1971, 28:19902 (INR--1410)
RED DWARF STARS/STAR EVOLUTION
Perturbing aspects of the companions of Barnard's star, 28:19287
REFRACTORIES/ELECTRON MICROSCOPY
Electron microscope for investigation of metals at high temperature, 28:18834

Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

19981 (ORNL-4804) ^{238}U NEUTRON ELASTIC-SCATTERING CROSS SECTIONS FROM 6.44 TO 8.56 MeV. Kinney, W. E.; Perey, F. G. **(Oak Ridge National Lab., Tenn.).** Jun 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $4.00.

is indexed as:

OAK RIDGE NATIONAL LAB., TENN.
^{238}U neutron elastic-scattering cross sections from 6.44 to 8.56 MeV, 28:19981 (ORNL-4804)
Analytical techniques for determining levels and fates of trace elements in a fossil-fueled steam plant, 28:17850 (CONF-730817-1)

Report Numbers

Technical report literature is also indexed using report numbers. This index includes information on where individual reports may be obtained. While not reports, patents and conference papers are indexed here as a matter of convenience.

GULF-RT-		
11023	28-20077	See AD-758689
HEDL-SA-		
548	28-20309	Dep. NTIS $3.00, 23p.
555	28-20410	Dep. NTIS $3.00, 11p.
556	28-20289	Dep. NTIS $3.25, 23p.
558	28-20290	Dep. NTIS $3.00, 12p.
573	28-20310	Dep. NTIS $12.50, 210p.
HEDL-TME-		
72-109	28-20344	AT $5.45
73-43	28-20312	Dep. NTIS $5.45, 69p.
73-44	28-18601	AT
HN-		
8145.3(Vol. 1)	28-20537	Dept. of Conservation, Sacramento, CA $3.00

AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Atomic Energy Commission reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

TABLE OF CONTENTS

Volume 29, Number 4, February 28, 1974

Category	Page
CHEMISTRY	701
Analytical and Separations Chemistry	701
Activation and Nuclear Reaction Procedures	701
Chemical and Spectral Procedures	703
Radiometric and Radiochemical Procedures	706
Separation Procedures	707
Inorganic, Organic, and Physical Chemistry	708
Chemical and Physicochemical Properties	708
Isotope Effects	709
Isotope Exchange and Isotope Separation	709
Feed Materials Processing	710
Radiation Chemistry	710
Radiochemistry and Nuclear Chemistry	711
Hot-Atom Chemistry	711
Properties of Radioactive Materials	712
Radioactive Waste Treatment	714
Radioisotope Production	716
Reactor Fuel Reprocessing	716
ENGINEERING	719
Energy Conversion	719
Facilities and Equipment	719
Heat Transfer and Fluid Flow	720
Materials Testing	721
Nuclear Explosions	722
Safety Engineering	722
ENVIRONMENTAL AND EARTH SCIENCES	723
Minerals and Ores	723
Radioactive Effluents	723
Radioactivity Monitoring and Transport	724
Atmosphere	724
Soil	725
Water	725
Ecosystems and Food Cycles	725
Radiometric Techniques	725
Site Surveys	727
Thermal Effluents	727
Chemical Effluents	728
INSTRUMENTATION	729
Radiation Detection Instruments	729
General Detectors and Monitors	729
Radiation Dosimeters	732
Nuclear Spectroscopic Instrumentation	733
High Energy Physics Instrumentation	735
Radiometric Instruments	735
Radiation Effects on Instrument Components, Instruments, or Electronic Systems	737
Miscellaneous Instruments	737
ISOTOPE AND RADIATION SOURCE TECHNOLOGY	739
Isotope Separation (Industrial)	739
Isotopic Power Sources	740

Category	Page
ISOTOPE AND RADIATION SOURCE TECHNOLOGY (Cont'd.)	
Radiation Sources	740
Design and Fabrication	740
Industrial Uses	741
LIFE SCIENCES	743
Radiation Effects on Biochemicals	743
Radiation Effects on Cells	744
Radiation Effects on Microorganisms	745
Radiation Effects on Plants	748
Radiation Effects on Animals	748
Man	748
Vertebrates	754
Invertebrates	759
Radionuclide Effects (Internal Source)	762
Man	762
Animals	762
Nuclide Kinetics and Toxicology	763
Man	763
Animals	764
Plants	766
Microorganisms	766
New Tracer Techniques	767
MATERIALS	776
Ceramics and Cermets	776
Metals and Alloys	782
Corrosion and Erosion	782
Preparation and Fabrication	784
Properties, Structure, and Phase Studies	785
Radiation Effects	791
Other Materials	794
NUCLEAR MATERIALS AND WASTE MANAGEMENT	797
Accountability and Safeguards	797
Disposal and Storage	797
Handling Equipment and Procedures	801
Transportation	801
PARTICLE ACCELERATORS	803
Design, Development, and Operation	803
Auxiliaries and Components	803
Ion Sources and Injection and Extraction Systems	804
Ion Optics and Field Calculations	804
Storage Rings	804
Experimental Facilities	805
PHYSICS (ASTROPHYSICS AND COSMOLOGY)	807
Cosmic Radiation	807
Stars	807
Quasi-Stellar, Radio, and X-Ray Sources	809
Solar Phenomena	812
Galaxies	815
Cosmology	816
Planetary Phenomena	817

TABLE OF CONTENTS (continued)

Category	Page
PHYSICS (ATMOSPHERIC)	818
Auroral and Ionospheric Phenomena	818
Magnetospheric Phenomena	820
PHYSICS (ATOMIC AND MOLECULAR)	825
Beams and Their Reactions	825
Atomic and Molecular Properties	825
Positronium, Muonium, and Muonic and Mesic Atoms and Molecules	826
Collision Phenomena	828
Atomic Theory	831
PHYSICS (ELECTROFLUID AND MAGNETOFLUID)	832
PHYSICS (HIGH-ENERGY)	833
Particle Interactions and Properties (Experimental)	833
Electromagnetic	833
Weak	833
Strong (Baryon-induced)	834
Strong (Meson-induced)	834
Particle Interactions and Properties (Theoretical)	836
General	836
Electromagnetic	837
Weak	839
Strong (General)	840
Strong (Baryon No. = 0)	841
Strong (Baryon No. = 1)	842
Strong (Baryon No. > 2)	843
Particle Invariance Principles and Symmetries	845
General	845
Applications (Electromagnetic and Weak)	845
Applications (Strong)	845
Scattering Theory	845
PHYSICS (LOW-TEMPERATURE)	848
Superfluidity	848
Superconductivity	848
Equipment and Devices	849
PHYSICS (NUCLEAR)	851
Neutron Interactions with Matter	851
Nuclear Properties and Reactions, $A < 5$	851
Nuclear Properties and Reactions, $6 < A < 19$	853
Nuclear Properties and Reactions, $20 < A < 38$	855
Nuclear Properties and Reactions, $39 < A < 58$	857
Nuclear Properties and Reactions, $59 < A < 89$	858
Nuclear Properties and Reactions, $90 < A < 149$	859
Nuclear Properties and Reactions, $150 < A < 189$	861
Nuclear Properties and Reactions, $190 < A < 219$	861
Nuclear Properties and Reactions, $A > 220$	862
Nuclear Theory	863
PHYSICS (PLASMA AND THERMONUCLEAR)	867
Confinement and Heating	867
Diagnostics	870
Kinetics (General)	871
Kinetics (Experimental)	872
Kinetics (Theoretical)	873
Production	875
Stability	875
Thermonuclear Engineering and Equipment	877
Wave Phenomena	880
PHYSICS (RADIATION AND SHIELDING)	882
Radiation Physics	882
Radiation Source Calibration and Standardization	882
Shielding Calculations and Experiments	882
PHYSICS (THEORETICAL)	883
General	883
Quantum Field Theories	883
Gravitation and General Relativity	885
REACTOR TECHNOLOGY AND REGULATION	887
Power Reactors, Non-Breeding, BWR-Type	887
Power Reactors, Non-Breeding, PWR-Type	888
Power Reactors, Non-Breeding, Graphite Moderated	889
Power Reactors, Non-Breeding, Otherwise Moderated	890
Power Reactors, Breeding	891
Research, Test, and Experimental Reactors	895
Production and Materials Testing and Processing Reactors	898
Propulsion and Package Reactors	898
Reactor Safety and Environmental Aspects	900
Reactor Theory and Calculation	909
Reactor Components and Accessories	909
Reactor Fuels	911
Reactor Control Systems	911
Nuclear Power Plant Economics	912
Reactor Fuel Cycle Economics	913
Reactor Licensing and Regulation	913
GENERAL	916
Energy Utilization and Economics	916
Information Handling	919
Law	919
Management	919
Mathematics and Computers	919
Miscellaneous	920
CORPORATE INDEX	INDEX-1
PERSONAL AUTHOR INDEX	INDEX-16
SUBJECT INDEX	INDEX-53
REPORT NUMBER INDEX	INDEX-142

STAFF OF NUCLEAR SCIENCE ABSTRACTS

Editor and Production Manager
David E. Bost

Associate Editors
Everett J. Hoffman
John W. Norris
Lawrence T. Whitehead

Section Editors
M. Catherine Grissom
Robert C. Kelly
Henry D. Raleigh
Charles E. Stuber
Lee M. Thompson

Report Evaluators
John H. Mitchell
Mary H. Newman

Descriptive Cataloging Specialist
J. Paul Meredith

Subject Heading Specialist
Sidney F. Lanier

Corporate Author Specialist
Clara L. Fox

Report Number Specialist
Helen W. White

Abstractors
E. Ray Bedford
Jane G. Buchanan
D. Lamar Cason
David C. Cunningham
Theodore F. Davis
James R. Dulaney
Martha W. Gerrard
Helga B. Gerstner
Carolyn D. Houston
Lynda H. Kern
W. Hugh Kinser
Lisbeth C. Lieberman
William D. Matheny
Dora H. Moneyhun
Jean F. Peckham
Mona H. Raridon
Julia S. Redford
Stanley J. Rimshaw
Jesse W. Rushing
Robert W. Rutkowski
Francis S. Sachs
Lila B. Smith
Polly C. Summers
Helen L. Ward
Milton O. Whitson
Martha C. Wilson

Publishing Coordinator
Charles R. Bruce

Computer Processing Coordinator
Noboru Kawakami

Communication concerning the editorial policy and content of *Nuclear Science Abstracts* should be addressed to the Editor, *Nuclear Science Abstracts*, USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

Use of funds for printing this publication approved by the Director of the Office of Management and Budget, June 19, 1972.

Volume 29, Number 4 February 28, 1974

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Refer also to abstracts 7705 and 7843.

7481 COMPREHENSIVE INORGANIC CHEMISTRY. Volume 2. Trotman-Dickenson, A. F. Oxford; Pergamon Press Ltd. (1973). 1628p.

Chapter titles of Volume 2 are germanium; titanium; lead; nitrogen; phosphorus; arsenic, antimony, and bismuth; oxygen; sulfur; selenium, tellurium, and polonium; fluorine; chlorine, bromine, iodine, and astatine. Abstracts were prepared for the chapters on selenium, tellurium, and polonium; fluorine; and chlorine, bromine, iodine, and astatine. (DHM)

Analytical and Separations Chemistry

Activation and Nuclear Reaction Procedures

Refer also to abstracts 7596, 7726, and 8458.

7482 (BMFT-FBK-73-27) PROGRAM FOR RESEARCH AND DEVELOPMENT OF ACTIVATION ANALYSIS IN THE FEDERAL REPUBLIC OF GERMANY. Project Committee Activation Analysis in the Federal Ministry for Research and Technology. Lux, F. (comp.). (Technische Univ. Munich (F.R. Germany)). Sep 1973. 91p. (In German). Dep. NTIS (U. S. Sales Only) $6.75.

The possibility of a broader practical application of activation analysis in the Federal Republic of Germany has been examined. At present there are 37 activation analysis working groups in the FRG. In order to be able to solve many analytical problems in a more advantageous and routine manner, it would seem purposeful to make greater use of activation analysis. From the general scientific viewpoint, the present suitable facilities and from the already existing scientific activities, four beneficial intentions are proposed: (1) Instrumental multi-element determination, (2) determination of major components, (3) special activation techniques, and (4) service centers in Berlin, Juelich, Karlsruhe and Munich. The project "Automatic methods of neutron activation analysis in environmental research" of the project committee "Environmental chemicals and biozides" has also been included in the research and development program. (auth)

7483 (JINR-P12-7446) EXPRESS INSTRUMENTAL DETERMINATION OF GERMANIUM AND SOME HALOIDS BY ACTIVATION METHOD USING NEUTRON GENERATOR AND GAMMA-SPECTROMETRY WITH SEMICONDUCTOR Ge(Li) DETECTOR. Duda, I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Germanium and halogens were determined over the analytical photopeaks of isomers and isotopes ^{75m}Ge, ^{34m}Cl, ^{19}O, ^{126}I, and ^{79}Br, produced in the reactions (n,2n) or (n,p) when irradiated with fast 14-MeV neutrons. Use of Ge(Li) detector (v = 40 cm^3) of high resolution and efficiency made it possible to determine simultaneously several elements in one sample of the substance under analysis. The detection limits for the present conditions are from 2.3×10^{-3}g (iodine) to 1.8×10^{-4}g (germanium). The method is suitable for express determination of the mentioned elements as microcomponents in the samples of 0.1-0.2 g. The determination duration is about 15 min. (auth)

7484 DETERMINATION OF TRACES OF MERCURY [IN BIOLOGICAL SAMPLES] BY NEUTRON-ACTIVATION ANALYSIS. Bader, H.; Hedrich, E. (INRESCOR, Schwerzenbach, Switzerland). Lebensm.-Wiss. Technol.; 5: No. 5, 178-180 (1972).

The sample (0.2 g), activated with thermal neutrons (2×10^{17} neutrons per sq. cm), is treated with H_2SO_4-HNO_3 (1:4) (10 ml), ^{203}Hg is added in 50 μg of Hg carrier, and the mixture is placed in a Bethge apparatus. After the acid treatment, the soln. is adjusted to pH 1 with conc. aq. NH_3 (10 ml), urea (5 g) is added to remove oxides of N, and the Hg is extracted with 0.4mM dithizone in CCl_4 (3 ml). The organic phase is extracted with a mixture of 6M HCl (2 ml) and 2M KBr (1 ml), and the γ spectrum is recorded, with the use of a Ge(Li) detector. Measurements on the ^{197}Hg peak give a rectilinear calibration graph for 0.05 to 5 μg of Hg; the ^{203}Hg peak is used to calculate the separation efficiency so that a correction can be applied for incomplete recovery of Hg. The coeff. of variation ranges from ±13% for 0.2 ppM of Hg to ±50% for 0.05 ppM. (duplicate determinations). The method has been applied to, e.g., hair, mud, cod-liver oil and potatoes. (Anal. Abstr.)

7485 DETERMINATION OF SODIUM IN HIGH-PURITY ZINC AND SELENIUM BY NEUTRON ACTIVATION. Yoshida, H.; Yonezawa, C. (Japan Atomic Energy Research Inst., Tokai). Jap. Anal.; 22: No. 7, 929-931(Jul 1973). (In Japanese).

7486 NUCLEAR BACKSCATTER ANALYZER FOR QUANTITATIVE ANALYSIS USING ISOTOPE RATIO METHOD. Rasmussen, J. O., Jr. US Patent 3,761,225. 25 Sep 1973. Filed Date 2 Dec 1970. 10p.

The method and apparatus for measuring the concentration of various selected compounds in a sample by monitoring nuclear reactions resulting from irradiation of the sample by alpha particles. Prior to the irradiation, the sample is "spiked" with a measured amount of a substance containing an element of the compound to be measured in the form of a rare isotope. Backscattered alpha particles are detected and analyzed as a function of their relative energy levels. The ratio of the number of alpha particles having energy levels corresponding to the element of the compound whose concentration is to be measured, to the number of alpha particles having energy levels corresponding to the isotope of this element, is an accurate measure of the concentration of the selected compound. (auth)

7487 SIMULTANEOUS DETERMINATION OF URANIUM AND THORIUM BY INSTRUMENTAL NEUTRON ACTIVATION AND HIGH RESOLUTION X-RAY SPECTROMETRY. Mantel, M.; Amiel, S. (Soreq Nuclear Research Centre, Yavne, Israel). Anal. Chem.; 45: No. 14, 2393-2399(Dec 1973).

Reactor neutron activation followed by high resolution x-ray spectrometry has been applied to the nondestructive and simultaneous determination of uranium and thorium in geological materials. The L x-rays of Np and Pa obtained from neutron activated U and Th, respectively, were measured with a 100 mm^2 Si(Li) spectrometer. A limit of detection of 10^{-2} μg for U and 10^{-1} μg for Th was obtained by the irradiation of samples (~10 to ~100 mg) for 20 minutes at a neutron flux of 10^{13}n cm^{-2} sec^{-1} and employing a 4% counting geometry. The accuracy of the assay is within a few per cent. The different sources of error, as well as the possibilities of minimizing them, were studied. (auth)

7488 THERMAL NEUTRON ACTIVATION: SAMPLE PREPARATION UTILIZING GRAPHITE AS A DILUENT. Stalnaker, N. D. (Univ. of New Mexico, Albuquerque); Kenna, B. T.; Kahn, M. J. Radioannal. Chem.; 14: No. 2, 395-400(Apr 1973).

A sample preparation method has been developed which produces both standard and unknown samples of the same size, shape, composition, and density (a necessary condition for minimum error). A solution of standard or unknown material was pipetted

onto graphite wetted with acetone; the material was dried and mixed with additional graphite to give a homogeneous mixture containing ≥99% graphite. Portions of the mixture were pressed into uniform cylindrical pellets. Application of the method to the activation analysis of several copper compounds gave results that generally agreed with analysis by thiosulfate titration of liberated iodine to within less than 1%. (auth)

7489 ACTIVATION METHOD OF DETERMINING Mo, Al, Ca, Cl, Mn, Na, AND K IN SOIL–PLANT SAMPLES. Rustamov, R.; Khatamov, Sh.; Orestova, I. I.; Kist, A. A. At. Energ. (USSR); 34: No. 6, 476(Jun 1973). (In Russian).

With the use of a high-resolution germanium–lithium semiconductor detector it is possible to run activation analyses on series of 40 to 50 soil samples with the simultaneous determination of Al, Ca, Mn, Cl, Na, and K. Samples of 100 to 300 mg from soil and various parts of the cotton plant were irradiated in the vertical channel of the VVR-S reactor at a flux of 10^{12} neutrons cm^{-2} sec^{-1} for a period of 8 to 10 min. The samples were encased in cadmium to determine molybdenum. Quantitative determination of the elements was carried out by noting the gamma intensities at the following energies: ^{101}Mo(1021 keV), ^{28}Al (1780 keV), ^{49}Ca (3083 keV, 2061 keV), ^{38}Cl (2160 keV), ^{46}Mn (847 keV), ^{42}K (1524 keV), and ^{24}Na (1368 keV, 2750 keV). In determining aluminum the contribution from the interferring reactions ^{28}Si(np)^{28}Al and ^{31}P(nα)^{28}Al was taken into account. The actual sensitivity of the method in determining Mo was 2.8×10^{-5} g/g, Al 8.4×10^{-7} g/g, Ca 7.5×10^{-4} g/g, Mn 1.2×10^{-6} g/g, Cl 2.1×10^{-7} g/g, K 7.1×10^{-4} g/g, and Na 5×10^{-6} g/g. The results of analyses on various parts of the cotton plant showed that, during sickness, the transfer of manganese from plant organs to fruiting elements was impaired and that the concentration of manganese in the leaves, roots, and other organs increased. (TTT)

7490 INTERFERENCES IN PHOTOACTIVATION ANALYSIS OF ZIRCONIUM AND TIN. Galatanu, V.; Grecescu, M. (Inst. of Atomic Physics, Bucharest). J. Radioanal. Chem.; 14: No. 2, 445-454(Apr 1973).

A detailed study of possible interferences in the photoactivation analysis of Zr and Sn with a 25-MeV betatron and Ge(Li) detectors is undertaken. The minimum detectable masses of Zr and Zn with and without interfering elements is deduced. The maximum amounts of interfering elements which can be neglected are derived. (auth)

7491 DETERMINATION OF IMPURITIES IN NATURAL DIAMONDS USING NEUTRON ACTIVATION AND HIGH-RESOLUTION GAMMA-SPECTROMETRY. Randa, Z. (Institute of Mineral Raw Materials, Kutna Hora, Czech.); Benada, J.; Kuncir, J.; Kurimsky, J. J. Radioanal. Chem.; 14: No. 2, 437-443(Apr 1973).

Thirty-five natural diamonds from six widely differing localities, weighing from 3.6 mg to 305.3 mg were subjected to instrumental neutron activation analysis using high-resolution semiconductor gamma-spectrometry. By means of short-term and long-term activation in a nuclear reactor, Na, Sc, Cr, Mn, Co, La, Ce, Sm, Eu, Hf, Au, Hg, and Th were determined in all the samples, K, Sr, Ag, Cs, Ba, Yb, Lu, and W in some, and qualitative determination was carried out with Ca, Fe, Ni, Ga, As, Zr, Sb, Tb, Dy, Ta, Ir, and U. The study serves as a basis for the study of the relationship between the color, morphology and luminescence of diamonds and their impurity contents. (auth)

7492 NEW METHOD FOR QUANTITATIVE DETERMINATION OF COPPER BY PHOTOACTIVATION ANALYSIS USING A BETATRON. Galatanu, V.; Grecescu, M. (Inst. for Atomic Physics, Bucharest). J. Radioanal. Chem.; 14: No. 2, 427-435 (Apr 1973).

An original method has been developed for the quantitative determination of copper by photoactivation analysis. The main advantage of this new method with respect to the conventional one is its high specificity. The method is based on the reaction ^{63}Cu(γ,2n)^{61}Cu and on the detection of the 284-keV and/or 655-keV γ-rays of ^{61}Cu(T = 3.32 h). By a suitable choice of the irradiation and measuring conditions, a threshold sensitivity better than 10^{-3} can be achieved for copper determination, if a 25-MeV betatron is employed. (auth)

7493 DETERMINATION OF SOME ELEMENTS IN ROCKS BY INSTRUMENTAL PHOTON ACTIVATION ANALYSIS. Das, H. A.; Gerritsen, G. A. V.; Hoede, D.; Zonderhuis, J. (Reactor Centrum Nederland, Petten). J. Radioanal. Chem.; 14: No. 2, 415-426(Apr 1973).

This text describes the instrumental determination of some elements in silicate samples of ≈1 g by photon activation. The following elements can be determined: In acidic rocks: Mg, Ca, Ti, Mn, Sr, Zr, and Nb, in ultramafic rocks: Mg, Cr, Ni, and Mn. The relative standard deviation is a few percent. (auth)

7494 DETERMINATION AND GEOCHEMICAL SIGNIFICANCE OF TRACE ELEMENTS IN IRAQI CRUDE OILS USING INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS. Al-Shahristani, H.; Al-Atyia, M. J. (Nuclear Research Inst., Bagdad). J. Radioanal. Chem.; 14: No. 2, 401-413(Apr 1973).

The trace-element composition of crude oil was studied using instrumental neutron activation techniques and a large-volume high-resolution Ge(Li) detector. A total of 29 elements were determined in oils representing the various producing formations of the Iraqi oil fields. These were: Al, Ar, As, Au, Br, Ca, Cl, Co, Cr, Cu, Eu, Fe, Ga, Hg, K, La, Mn, Mo, Na, Ni, Re, S, Sb, Sc, Se, Sm, V, W, and Zn. The significance of these trace elements in the geochemical investigation of crude oil is discussed. (auth)

7495 USE OF AN ACTIVATION DETECTOR IN THE DETERMINATION OF BERYLLIUM BY PHOTON ACTIVATION. Das, H. A.; Hartog, F. A.; de Witte, F. A. (Reactor Centrum Nederland, Petten). J. Radioanal. Chem.; 14: No. 2, 375-385 (Apr 1973).

The determination of traces of beryllium in large samples by the (γ,n) reaction, using a ^{124}Sb gamma source, is in general hampered by the rather high handling costs when a BF_3 counter is used for the neutron detection. When manganese dioxide is used as an activation detector, the analysis is possible with a simple facility that can be stored in a water basin. The lower limit of the determination is ~1 μg/g for a sample weight of 50 g. (auth)

7496 DETERMINATION OF ^{135}Cs IN SODIUM FROM AN IN-PILE LOOP BY ACTIVATION ANALYSIS. Stamm, H. H. (Kernforschungszentrum, Karlsruhe, Ger.). J. Radioanal. Chem.; 14: No. 2, 367-373(Apr 1973).

Several months after shut-down, ^{137}Cs and ^{134}Cs were the main activities in coolant residues from an in-pile sodium loop where a fuel pin had failed at 40000 MWd/t burn-up. FR2-reirradiation of coolant residues increased ^{134}Cs and generated ^{136}Cs, thus indicating the presence of stable ^{133}Cs and of long-lived ^{135}Cs in the samples. The amount of ^{135}Cs calculated from ^{136}Cs activities was of the same quantity as the number of ^{137}Cs atoms. (auth)

7497 DETERMINATION OF COPPER IN HIGH-PURITY TIN BY REACTOR NEUTRON ACTIVATION ANALYSIS. Maenhaut, W.; Adams, F.; Hoste, J. (Ghent Univ.). J. Radioanal. Chem.; 14: No. 2, 351-356(Apr 1973).

For the determination of very low concentrations of copper in tin, an analytical method involving reactor neutron activation was developed whereby the copper activity was separated from the tin matrix by extraction of the Cu(I) cuproin complex in n-amyl alcohol. A new decontamination technique was sought in order to remove the copper contamination present on the tin surface. Pre-irradiation removal of the tin surface combined with post-irradiation etching appeared to be the most efficient. (auth)

7498 DETERMINATION OF TRACE IMPURITIES IN TIN BY NEUTRON ACTIVATION ANALYSIS. III. Simultaneous Determination of 15 Elements. Maenhaut, W.; Adams, F.; Hoste, J. (Ghent Univ.). J. Radioanal. Chem.; 14: No. 2, 295-316(Apr 1973).

A method was developed for the determination of 15 trace elements in tin. High-purity tin samples (99.9999 and 99.999%) as well as tin of technical quality were analyzed. Reactor neutron activation of the tin samples was followed by distillation of the matrix activities from a $HBr-H_2SO_4$ medium and Ge(Li) gamma spectrometry of the distillation residue. The sensitivity of the method is generally high. For the high-purity samples the detection limits vary from 0.02 ppB (scandium) to 200 ppB (iron) for irradiation of 1 g of tin for 1 week at a thermal flux of $5 \cdot 10^{12}$ $n \cdot cm^{-2}$ sec^{-1}. To decontaminate the surface of the tin samples, pre- and post-irradiation etching procedures were applied. The efficiency of these etching techniques was studied. (auth)

7499 NEUTRON ACTIVATION DETERMINATION OF SILVER IN ROCKS AND MINERALS USING ORGANIC EXTRACTION FOR SILVER SEPARATION. Gilbert, E. N.; Shatskaya, S. S.; Mikhailov, V. A.; Torgov, V. G. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). J. Radioanal. Chem.; 14: No. 2, 279-283(Apr 1973).

A rapid method for determination of silver in rocks and minerals by neutron activation was developed. The method is based on the quantitative and selective separation of silver by organic sulfide extraction. (auth)

7500 APPLICATION OF α-BENZOINOXIME FOR SUBSTOICHIOMETRIC EXTRACTIVE SEPARATION OF COPPER IN ACTIVATION ANALYSIS. Zmijewska, W. (Inst. of Nuclear Research, Warsaw). J. Radioanal. Chem.; 14: No. 2, 267-278 (Apr 1973).

A method has been developed for the substoichiometric extraction of copper with a solution of α-benzoinoxime in chloroform. The separation can be carried out in the absence or in the presence of tartaric acid at pH 6.8-7.0 and 9.5, respectively. In the presence of tartaric acid no interference has been observed. The method has been applied to the determination of copper in biological material, silicon, aluminum and kaolin by the neutron activation method. (auth)

7501 NEUTRON ACTIVATION ANALYSIS FOR THE DETECTION OF FIREARM DISCHARGE RESIDUES COLLECTED ON COTTON SWABS. Hoffman, C. M. (Dept. of the Treasury, Washington, DC). J. Ass. Offic. Anal. Chem.; 56: No. 6, 1388-1390(Nov 1973).

Cotton swabs moistened with 5% HNO_3 are frequently used by police investigators to process a suspect's hands for the presence of gunshop residue. A neutron activation analysis procedure is described for testing these swabs for barium and antimony, which are commonly found in firearm residues. The limitations of the method are also discussed. (auth)

7502 IMPROVEMENTS IN AND RELATING TO ACTIVATION ANALYSIS. Boswell, C. R. (to United Kingdom Atomic Energy Authority). British Patent 1,321,869. 4 Jul 1973. Filed date 10 Aug 1970. 8p.

Reference is made to methods for the on-line activation analysis of flowable samples. In the method described, the sample is irradiated at a selected point in its flow path and the resulting radiation is detected at a second point in the flow path, downstream of the irradiation point, the flow rate being selected, in relation to the volume of sample in the part of the flow path between the first and second points, so that the activity is a maximum at the second point. The method may be applied to the simultaneous determination of several substances. In the case of two substances there are two detection points, related to the respective half-lives of the substances. The flow rates are selected by reference to calibration curves. The flowable sample may be a fluid or a fluidized powder, and the flow path provided by a coiled pipe. If the sample consists of solid particles the flow path may be provided by a movable conveyor. (UK)

7503 IMPROVEMENTS IN AND RELATING TO ACTIVATION ANALYSIS. (to United Kingdom Atomic Energy Authority). British Patent 1,321,870. 4 Jul 1973. Filed date 10 Aug 1970. 5p.

Reference is made to methods for the on-line activation analysis of flowable samples. The method described applies to the simultaneous determination of two or more substances, of different half-lives. The sample is irradiated at a selected point in its flow path and the resulting radiation is detected at a second point in the flow path, downstream of the irradiation point, the flow rate being selected so as to be sufficiently high for the activity produced by each substance to be substantially independent of the rate. The sample may be a fluid or a fluidized powder, and the flow path provided by pipe means, or particulate material with the flow path provided by conveyor means. (UK)

7504 RELATIONSHIPS AMONG VARIOUS ELEMENTS IN THE ATMOSPHERE OVER OSAKA DISTRICT. Mamuro, T.; Matsuda, Y.; Mizohata, A.; Matsunami, T. (Radiation Center of Osaka Prefecture, Sakai, Japan). Annu. Rep. Radiat. Center Osaka Prefect.; 13: 1-15(Mar 1973).

In order to study in detail the area depencency of the concentrations of various elements in the atmosphere over Osaka district, simultaneous measurements were made at thirty stations by the use of instrumental neutron activation analysis and energy dispersive x-ray fluorescence analysis. From the measured average concentrations in four weeks, the concentration variation over the area was studied by calculating the coefficients of variation for 31 elements. In order to study the relationships among concentrations of various elements, linear correlation coefficients were computed between all possible pairs of elements including dust concentrations. (auth)

7505 POSSIBILITY OF RAPID DETERMINATION OF IRON AND ALUMINUM IN REPRESENTATIVE SAMPLES OF PHOSPHORITES. Volokh, V. A. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 114-118 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The association of neutron activation and radiation methods with the use of isotope and neutron Po-Be sources make possible the rapid determination in representative samples of phosphorites containing elements forming the sesquioxides Fe_2O_3 and Al_2O_3 with a precision satisfying the requirements of geological prospecting of these elements. (tr-auth)

7506 AUTOMATED RADIOCHEMICAL TECHNIQUE FOR MEASUREMENT OF IMPURITY CONCENTRATION PROFILES. Restelli, G.; Girardi, F.; Mousty, F.; Ostidich, A. (Joint Nuclear Research Center, Ispra, Italy). Nucl. Instrum. Methods; 112: No. 3, 581-589(1973).

An automated system for the analysis of impurity concentration profiles in diffused or ion-implanted silicon samples is described. It makes use of radiotracing or radioactivation for concentration measurements and of anodic oxidation for sectioning. Silicon layers as thin as 160 Å can be reproducibly removed and for many elements the precision in the profile determination is ±15% for concentrations as low as 10^{16} atoms/cm^3. The system appears applicable to materials other than silicon. The advantages of radiotracing and radioactivation are discussed and compared to other techniques for concentration-profile measurement. Anodic oxidation is also discussed and compared with other sectioning techniques. (auth)

7507 DETERMINATION OF SMALL CONCENTRATIONS OF BORON USING NEUTRON GENERATOR. Zitnansky, B.; Valent, J. (Research Inst. of Welding, Bratislava). Jad. Energ.; 19: No. 7, 229-231(1973). (In Czech).

A combined absorption and activation method was developed for the determination of small concentrations of boron in metals. This method provides for the determination of less than 0.001% B in steel. The source of neutrons was the neutron generator NA-3 an Hungarian product. A suitable moderator was made from polyethylene. Activities of indium indicators were measured, one of them placed before and the other after the analyzed sample. (auth)

7508 DETERMINATION OF TRACES OF EUROPIUM IN AN ORGANIC COMPLEX OF GADOLINIUM. Kapisovsky, V.; Whitley, J. E. (Scottish Universities Research and Reactor Centre, Glasgow). Radiochem. Radioanal. Lett.; 15: No. 4-5, 291-298(20 Nov 1973).

The determination of traces of Eu in Gd/benzoyltrifluoroacetylacetonate/piperidinium cation by instrumental neutron activation analysis is described. Account is taken of the self-shielding of Gd by the method of standard additions and the results are compared with those obtained with an external standard. Homogeneous standard addition is achieved by dissolving the complex in ethanol. (auth)

7509 DETERMINATION OF OXYGEN IN CESIUM BY γ PHOTON ACTIVATION AND SEPARATION OF THE ^{15}O. Nordmann, F. (Ecole Superieure de Chimie, Mulhouse, France); Tinelli, G.; Engelmann, C. Radiochem. Radioanal. Lett.; 15: No. 4-5, 307-315(20 Nov 1973). (In French).

A γ-photon activation analysis method for the determination of oxygen in cesium is described. The technique developed enables metal analysis in the bulk of the sample by mechanically scraping the surface of cesium after its irradiation in the solid state. The ^{15}O is then chemically separated in a short time. The calibration curves are plotted. Analytical results are given. They indicate that cesium contains 5 to 10 μg per gram of oxygen. The method used enables 0.1 μg per gram of oxygen to be determined in a few minutes and to avoid contamination during packing. (auth)

7510 DETERMINATION OF CARBON, NITROGEN, OXYGEN, FLUORINE, CHLORINE, AND POTASSIUM BY PHOTON ACTIVATION METHOD. Sharma, H. D.; Smith, D. H.; Wikman, R. T. (Univ. of Waterloo, Ont.). Radiochem. Radioanal. Lett.; 15: No. 4-5, 317-324(20 Nov 1973).

The accuracy in the determination of C, N, O, F, Cl, and K by the photon activation method has been investigated with a view to apply the technique for routine analysis of compounds. Procedures for accurate analysis have been suggested. A precision of 0.8% in the elemental determinations was obtained. (auth)

7511 QUANTITATIVE DETERMINATION OF BROMINE IN A PESTICIDE BY ACTIVATION ANALYSIS WITH 14-MeV NEUTRONS. Segebade, C. (Bundesanstalt fuer Materialpruefung, Berlin). Radiochem. Radioanal. Lett.; 15: No. 4-5, 251-260(20 Nov 1973). (In German).

The bromine content in a pesticide was determined by nondestructive 14-MeV neutron activation analysis using γ spectrometry. The γ spectra were evaluated by a computer. Bromine amounts of 50 to 300 μg could be determined within about 15 min. (auth)

Chemical and Spectral Procedures

Refer also to abstracts 7615, 7848, and 9700.

7512 (ICP-1029) ANALYTICAL METHODS MANUAL. Part I. Methods Used by the Remote and Service Analysis Laboratory. Crawford, J. M. (comp. and ed.). (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs – Operations Office). Oct 1973. Contract AT(10-1)-1375. 588p. Dep. NTIS $13.60.

7513 (JEN-269) SPECTROGRAPHIC DETERMINATION OF BORON AND SILICON IN URANIUM TETRAFLUORIDE: STUDY OF THE CHEMICAL REACTIONS IN THE ELECTRODE CAVITY WHEN ZnO IS USED AS A URANIUM EXCITATION SUPPRESSOR. Alduan, F. A.; Capdevila, C.; Roca, M. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

A method has been developed for determining traces of boron and silicon in uranium tetrafluoride. Use is made of zinc oxide to decrease the volatilization of uranium and achieve high sensitivities. The thermochemical reactions which occur in the anode cavity during the arcing process have been investigated. UO_2 and a uranium, zinc and fluorine compound, both less volatile than uranium tetrafluoride, are formed. (auth)

7514 (K-1848) SULFUR ISOTOPE RELATIVE RATIOS DETERMINED BY MASS SPECTROMETRY. Howard, O. H. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 5 Dec 1973. Contract W-7415-eng-26. 12p. Dep. NTIS $4.00.

The ratio of the sulfur isotope ratio, $^{34}S/(^{32}S + ^{33}S)$, in a sample of sulfur hexafluoride to that in an isotopically different sample (relative ratio) is determined to ±0.00003 (standard deviation) at relative ratios of 1.003-1.007 and near-natural isotopic abundances. (auth)

7515 DETERMINATION OF URANIUM IN THE SOIL. Szabo, E. Igiena (Bucharest); 21: No. 5, 309-312 (May 1972).

A spectrophotometric method for the determination of natural uranium in soil using "Arsenazo III" reagent is described. The sample is totally solubilized by disaggregation in hydrofluoric acid or in a mixture of nitric and hydrochloric acid (1:1). The uranium is co-precipitated with tannic acid. Prior to determination, hexavalent uranium is reduced to tetravalent uranium with zinc to avoid interference from thorium – 232 or other ions. Determination is made spectrophotometrically in glass dishes, using a layer thickness of km and a wavelength of 660 nm. Sensitivity is 0.5 μg U^{4+}/25 ml. This method will be of interest to firms processing uranium minerals and to public health bodies. (Occup. Saf. Health Abstr.)

7516 STANDARD METHODS FOR CHEMICAL: MASS SPECTROMETRIC, AND SPECTROCHEMICAL ANALYSIS OF NUCLEAR-GRADE URANIUM DIOXIDE POWDERS AND PELLETS. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 39p. (ASTM-C-696-72).

Procedures described include uranium by ferrous sulfate reduction in phosphoric acid and dichromate titration method; uranium and oxygen–uranium atomic ratios by the ignition (gravimetric) impurity correction method; oxygen–uranium atomic ratios by the polarographic method; carbon by direct combustion–thermal conductivity method; chloride and fluoride by pyrohydrolysis ion selective electrode method; moisture by the coulometric electrolytic moisture analyzer method; nitrogen by the Kjeldahl method; sulfur by distillation spectrophotometric method; isotopic uranium composition by multiple filament surface ionization mass spectrophotometric method; trace elements by spectrochemical method; volatile fluoride impurities by spectrochemical method; silver by spectrochemical method; rare earths by copper spark-spectrochemical method; impurity elements by spark-source mass spectrographic method; surface area by nitrogen absorption method; and total gas in reactor-grade uranium dioxide pellets. (DHM)

7517 STANDARD METHODS FOR CHEMICAL, MASS SPECTROMETRIC, AND SPECTROCHEMICAL ANALYSIS OF NUCLEAR-GRADE PLUTONIUM DIOXIDE POWDERS AND PELLETS. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 37p. (ASTM-C-697-72).

Methods included are plutonium sample handling; plutonium by controlled-potential coulometry; plutonium by ceric sulfate titration; plutonium by amperometric titration with iron(II); nitrogen by distillation-nessler reagent (spectrophotometric method); carbon (total) by the direct combustion thermal conductivity method; chloride and fluoride by pyrohydrolysis; sulfur by distillation–spectrophotometric method; isotopic composition by mass spectrometry; rare earths by copper spark-spectrochemical method; trace elements by the carrier-distillation spectrochemical method; impurities by a spark-source mass spectrographic method; and moisture by the coulometric, electrolytic method. (DHM)

7518 STANDARD METHODS FOR CHEMICAL, MASS SPECTROMETRIC, AND SPECTROCHEMICAL ANALYSIS OF NUCLEAR-GRADE MIXED OXIDES ($(U,Pu)O_2$). 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 42p. (ASTM-C-698-72-a).

Methods included are uranium by controlled-potential coulometry; plutonium by controlled-potential coulometry; plutonium by amperometric titration with iron(II); nitrogen by distillation-nessler reagent (spectrophotometric method); carbon (total) by the direct combustion-thermal conductivity method; chloride and fluoride by pyrohydrolsis method; sulfur by distillation-spectrophotometry; moisture by the coulometric, electrolytic moisture-analyzer method; isotopic composition by mass spectrometry; rare earths by copper spark-spectrochemical method; trace impurities by spectrochemical carrier distillation method; impurities by a spark-source mass spectrographic method; total gas in reactor-grade mixed dioxide pellets; and tungsten by dithiol-spectrophotometric method. (DHM)

7519 STANDARD METHODS FOR CHEMICAL ANALYSIS OF STEEL, CAST IRON, OPEN-HEARTH IRON, AND WROUGHT IRON. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 46p. (ASTM-E-30-73).

Methods are described for determining manganese, phosphorus, sulfur, selenium, copper, nickel, chromium, vanadium, tungsten, titanium, lead, boron, molybdenum (α-benzoin oxime method), zirconium (cupferron–phosphate method), niobium and tantalum (hydrolysis with perchloric and sulfurous acids (gravimetric, titrimetric, and photometric methods)), and beryllium (oxide method). (DHM)

7520 STANDARD METHODS FOR CHEMICAL ANALYSIS OF TITANIUM AND TITANIUM-BASE ALLOYS. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 45p. (ASTM-E-120-71).

Methods are described for determining aluminum; chloride; chromium; niobium and tantalum (ion exchange–cupferron (gravimetric) method); copper; iron; magnesium; manganese; molybdenum (sulfide–permanganate titration and thiocyanate (photometric) methods); nitrogen; oxygen; palladium; silicon; tin; tungsten; vanadium; and zirconium (mandelic acid (gravimetric) method). (DHM)

7521 TENTATIVE METHODS FOR CHEMICAL ANALYSIS OF MOLYBDENUM. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-E-315-71-T).

Methods are described for the chemical analysis of molybdenum and molybdenum alloys. Methods included are nickel by the persulfate–dimethylgloxime photometric method; iron by the 1,10-phenanthroline photometric method; and silicon by the molybdenum blue-extraction photometric method. (DHM)

7522 TENTATIVE METHODS FOR CHEMICAL ANALYSIS OF FERRONIOBIUM. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 7p. (ASTM-E-367-70-T).

Methods are described that include niobium, tantalum, titanium by the ion exchange method, titanium by photometric method, niobium by gravimetric method; and tantalum by gravimetric method for >1% and by photometry for <1%. (DHM)

7523 TENTATIVE METHODS FOR CHEMICAL ANALYSIS OF FERROMOLYBDENUM. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 2p. (ASTM-E-368-71-T).

The dithizone photometric method for determining lead in ferromolybdenum in concentrations from 0.001 to 0.05% is described. (DHM)

7524 TENTATIVE METHODS FOR CHEMICAL ANALYSIS OF TUNGSTEN. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-E-397-70-T).

Methods are described for the chemical analysis of tungsten including molybdenum by the thiocyanate photometric method and iron by the 1,10-phenanthroline photometric method. (DHM)

7525 STANDARD METHOD FOR SPECTROCHEMICAL ANALYSIS OF URANIUM OXIDE (U_3O_8) BY GALLIUM OXIDE CARRIER DC ARC TECHNIQUE. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-E-402-70).

A method is described for the semiquantitative spectrochemical analysis of high-purity U_3O_8 for 32 elements. The as-received

sample is ignited to U_3O_8. It is important that the sample be in the same physical oxide form as are the comparison standards. The sample is mixed with pure gallium sesquioxide (Ga_2O_3) in the ratio of 98 parts U_3O_8 to 2 parts Ga_2O_3. The U_3O_8–Ga_2O_3 mixture is placed in a special cupped electrode and excited in a dc arc. Varying amounts of impurities either in vapor form or as solid particles are carried up into the arc stream, along with the vaporized Ga_2O_3, for excitation. The spectrum is recorded on a photographic plate and the selected lines are either visually compared with standard plates or photometrically measured and compared with synthetically prepared standards according to standard spectrochemical procedures. (DHM)

7526 STANDARD METHOD FOR SPECTROCHEMICAL ANALYSIS OF PLAIN-CARBON AND LOW-ALLOY STEEL BY THE POINT-TO-PLANE TECHNIQUE USING AN OPTICAL EMISSION SPECTROMETER. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-E-403-70).

A method is described for the spectrochemical analysis of plain-carbon and low-alloy steel for manganese, silicon, nickel, chromium, copper, aluminum, vanadium, tin, and molybdenum. (DHM)

7527 STANDARD METHOD FOR SPECTROCHEMICAL ANALYSIS OF CARBON AND LOW-ALLOY STEEL USING A VACUUM SPECTROMETER. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 8p. (ASTM-E-415-71).

A method is described for the simultaneous determination of 13 alloying and residual elements in carbon and low-alloy steels. The elements determined are: chromium; manganese, carbon, nickel, silicon, molybdenum, vanadium, copper, niobium, aluminum, phosphorus, sulfur and tin. (DHM)

7528 PROPOSED METHOD FOR SPECTROCHEMICAL ANALYSIS OF ALUMINUM AND ITS ALLOYS BY THE POINT-TO-PLANE, NITROGEN ATMOSPHERE, SPARK TECHNIQUE USING AN OPTICAL EMISSION SPECTROMETER. Annu. Book ASTM Stand.; 1171-1181(1973).

A method is described for the spectrochemical analysis of aluminum and its alloys for the following elements: silicon, copper, magnesium, zinc, tin, silver, nickel, manganese, iron, cobalt, chromium, zirconium, lead, bismuth, cadmium, beryllium, titanium, calcium, vanadium, gallium, sodium, boron, and lithium. (DHM)

7529 MASS SPECTROGRAPHIC DETERMINATION OF HYDROGEN THERMALLY EVOLVED FROM URANIUM AND URANIUM ALLOYS. Powell, G. L.; Condon, J. B. (Union Carbide Corp., Oak Ridge, TN). Anal. Chem.; 45: No. 14, 2349-2354(Dec 1973).

A hot-extraction, high-vacuum technique using mass-spectrographic detection has been used to determine the hydrogen content in uranium metal and uranium alloys. The time dependence of the evolution of hydrogen from the bulk metal and that from surface contamination was sufficiently different to resolve these two components. During the transient temperature portion of the analysis the hydrogen evolution rate from various uranium alloys was strongly influenced by the solubility of hydrogen in the alloy. Hydrogen due to sample surface contamination was approximately 0.5 weight-parts-per-million (wppM) which limited the lower limit of detection for bulk hydrogen to 0.05 wppM. Diffusion coefficients for hydrogen in uranium alloys were determined from hydrogen evolution rate data. (auth)

7530 TRACE DETERMINATION OF RUBIDIUM AND STRONTIUM IN SILICATE GLASS STANDARD REFERENCE MATERIALS. Moore, L. J.; Moody, J. R.; Barnes, I. L.; Gramlich, J. W.; Murphy, T. J.; Paulsen, P. J.; Shields, W. R. (National Bureau of Standards, Washington, DC). Anal. Chem.; 45: No. 14, 2384-2387 (Dec 1973).

Procedures have been developed for the accurate trace analysis of Rb and Sr by mass spectrometric isotope dilution. A new Sr isotopic assay technique capable of measuring the three abundant Sr isotopes to < 0.05% (ts) was combined with recently available high purity reagents and absolute standards to produce accurate and reliable analytical techniques. Application of these techniques to the determination of Rb and Sr in silicate glass Standard Reference Materials has resulted in accuracies within < 0.25% at the ppM (μg/g) level and within < 0.06% at the ppB (ng/g) level. (auth)

7531 STANDARD METHOD FOR SPECTROCHEMICAL ANALYSIS OF COPPER BY BRIQUET DC ARC TECHNIQUE. 1973 Annual Book of ASTM Standards. Part 32. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-E-414-71).

A method is described for the spectrochemical analysis of electrolytically refined copper for the following elements in the ranges indicated: lead (3 to 50 ppM); silver (5 to 40 ppM); nickel (4 to 40 ppM); iron (5 to 25 ppM); antimony (1 to 20 ppM); tin (2 to 15 ppM); tellurium (1 to 15 ppM); arsenic (1 to 10 ppM); and bismuth (0.1 to 5 ppM). (DHM)

7532 SEPARATION OF DAUGHTER NUCLIDES FROM ^{90}Sr–^{90}Y AND ^{140}La–^{140}Ba SYSTEMS BY THIN-LAYER CHROMATOGRAPHIC METHODS. Maki, Y. (Industrial Research Inst., Yokohama, Japan); Murakami, Y. J. Radioanal. Chem.; 14: No. 2, 317-324(Apr 1973).

The separation of daughter nuclides in the carrier-free state from ^{90}Sr–^{90}Y and ^{140}Ba–^{140}La aqueous solution systems was performed by thin-layer chromatographic methods. (1) When a silica gel adsorbent and a developer of 1N NaCl, KCl, NH_4Cl, $CaCl_2$, $SrCl_2$, or $BaCl_2$ solutions was employed, ^{90}Y and ^{140}La were retained at the origin, while ^{90}Sr and ^{140}Ba advanced with the developer front. Addition of gypsum as binder to the silica gel prevented the separation of the ^{140}Ba–^{140}La system, retaining both components at the origin. (2) When the ^{140}Ba–^{140}La system was developed with water on a silica gel adsorbent containing 5% of gypsum, which was treated with various concentrations of nitric acid, the Rf value of ^{140}La increased with the concentration of nitric acid used, reaching a maximum of 0.98 at 0.1N. The Rf value then decreased on the further increase of the concentration of nitric acid. When the same process was applied to the ^{90}Sr–^{90}Y system, there was no separation. The radiochemical purities of ^{90}Y and ^{140}La obtained in the above two ways were more than 99%. (auth)

7533 TENTATIVE METHOD FOR COLORIMETRIC DETERMINATION OF TECHNETIUM IN AQUEOUS SOLUTIONS. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 5p. (ASTM-E-417-70-T).

Quantitative determination of technetium in known volumes of aqueous solutions of nuclear fuel that contain radioactive nuclides is described. These solutions are from the processing of irradiated nuclear fuel and from the laboratory studies on irradiated nuclear fuel. The method is applicable to solutions that contain a minimum of 5 μg of technetium per sample, but it will detect as little as 0.4 μg. The method as described is limited to sample volumes of 2 ml or less, but reagent volumes can be scaled to accommodate larger sample aliquots. This method is based on measurement of the absorbance of the technetium thiocyanate complex in chloroform. All the technetium in the measured volume of sample is first oxidized to technetium (VII) by basic hydrogen peroxide. The alkalinity of the solution must be between 2.6 and 3.5 *M* for quantitative extraction of the technetium-tetrapropyl ammonium ion-association complex into the chloroform solvent. Color development is made in the chloroform phase with the addition of strong sulfuric acid, tetrapropylammonium hydroxide, and potassium thiocyanate. The colored complex absorbs at 513 nm, has a molar extinction coefficient of 46,000, and is stable for several hours. The concentration of technetium in the sample is determined from two comparison standards bracketing the unknown and processed concurrently, or from a standard curve. (LK)

7534 STANDARD METHOD OF TEST FOR URANIUM BY CONTROLLED-POTENTIAL COULOMETRY. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 8p. (ASTM-E-217-70).

Milligram amounts of uranium can be determined by controlled-potential coulometry. The determination is based on the direct electrolytic reduction of uranium (VI) at a mercury cathode under conditions such that the electrolysis proceeds with virtually 100% current efficiency, that is, under conditions such that the amount of electricity required to accomplish complete reduction is a measure of the amount of uranium(VI) present. Controlled-potential coulometry is a precise and accurate method of analysis. Uranium(VI) can be determined by this technique with a relative standard deviation as small as 0.05%, without significant bias in the results. The precision is poorer when the coulometric determination is used routinely on samples of various compositions, or when submilligram amounts of uranium are determined, or when it is necessary to precede the coulometric electrolysis with a chemical separation of uranium. Controlled-potential coulometry is inherently a selective method of analysis. By suitable choice of medium and electrode potential, uranium(VI) can be determined in the presence of many substances that interfere seriously in other highly precise methods for the determination of uranium. The use of a 0.5 *M* sulfuric acid medium, and reduction at −0.325 V versus the saturated calomel reference electrode (SCE) are recommended here; these conditions are suitable for general use. (LK)

7535 STANDARD METHOD OF TEST FOR URANIUM AND PLUTONIUM CONCENTRATIONS AND ISOTOPIC ABUNDANCES.

1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 9p. (ASTM-E-267-70).

An aliquot of solution to be analyzed is spiked with known amounts of ^{233}U and ^{242}Pu. U and Pu are separated by ion exchange and analyzed mass spectrometrically. This method is applicable to the determination of uranium (U) and plutonium (Pu) concentrations and their isotopic abundances in solutions that result from the dissolution of nuclear reactor fuels either before or after irradiation. A minimum sample size of 50 μg of irradiated U will contain sufficient Pu for measurement and will minimize the effects of cross contamination by environmental U. The procedure is applicable to dissolver solutions of uranium fuels containing plutonium, aluminum, stainless steel, or zirconium. Interference from other alloying constituents has not been investigated and no provision has been made in the method for fuels used in the ^{232}Th-^{233}U fuel cycle. (auth)

7536 ATOMIC-ABSORPTION DETERMINATION OF SELENIUM AND TELLURIUM IN PURE SILVER. Balandina, N. S.; Yudelevich, I. G.; Khrapai, V. P.; Abakumov, D. N. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 5, 93-96(Sep 1973). (In Russian).

Atomic absorption determination of selenium and tellurium in pure silver is described. Absorption of selenium and tellurium was measured at 196.1 nm and 214.3 nm accordingly at the Perkin-Elmer Model 303 atomic absorption spectrophotometer in propane-butane-air flame. The influence of HNO_3, Ag, and the other accompanying impurities has been studied. The method of atomic absorption determination of selenium and tellurium in pure silver has been suggested for content from $5 \cdot 10^{-6}$% tellurium and $5 \cdot 10^{-5}$% selenium. The variation coefficient is up to 10%. (auth)

7537 SECONDARY ISOTOPIC STANDARD FOR $^6Li/^7Li$ DETERMINATIONS. Flesch, G. S.; Anderson, A. R. Jr.; Svec, H. J. (Ames Lab., IA). J. Mass Spectrom. Ion Phys.; 12: No. 3, 265-272(Oct 1973).

A 13-kg sample of highly purified Li_2CO_3 prepared from virgin ores was assayed to have an absolute $^6Li/^7Li$ abundance ratio of 0.0832 ± 0.0002. This value was determined by a mass spectrometric comparison with a primary standard blended from specially prepared, highly enriched, well-characterized isotopic materials. The abundance ratio of the primary standard was 0.083656 ± 0.000003. The instrumental bias of the mass spectrometer was determined from isotopic ratio measurements of four primary standards having ^6Li abundances in the 7-8% range. (auth)

7538 MEASURING PROCEDURE AND CORRECTIONS FOR THE HIGH-PRECISION MASS-SPECTROMETRIC ANALYSIS OF ISOTOPIC ABUNDANCE RATIOS, ESPECIALLY REFERRING TO CARBON, OXYGEN, AND NITROGEN. Mook, W. G.; Grootes, P. M. (Univ. of Groningen, Netherlands). J. Mass Spectrom. Ion Phys.; 12: No. 3, 273-298(Oct 1973).

In order to determine isotopic abundance ratios such as $^{13}C/^{12}C$, $^{18}O/^{16}O$ or $^{15}N/^{14}N$, a mass spectrometer reads the ratio of the voltages generated by the isotopic ion beams, trapped by a double collector system. The effect of the gas inlet pressure on the voltage ratio in the case of nitrogen and carbon dioxide is determined experimentally. A knowledge of this pressure dependence provides a method of determining the voltage ratio, which is independent of the inlet pressure. The work of Craig is reviewed and a detailed treatment of the measuring procedure, of the corrections to be applied to the voltage ratios, viz. for pressure effects, of the way in which the voltage ratios are transformed into isotopic abundances, and of disturbing factors such as spectrometer background and sample contamination is given. Although the stable isotopes of carbon, oxygen and nitrogen in CO_2 and N_2, respectively, are specifically dealt with, the general equations also apply to isotopic analyses on other gases, such as argon ($^{36}Ar/^{40}Ar$) and SO_2 ($^{34}S/^{32}S$). (auth)

7539 INFRARED SPECTRA OF TITANIUM, ZIRCONIUM, AND HAFNIUM OXIDES. Kaminskii, B. T.; Plygunov, A. S.; Prokof'eva, G. N. (Kiev Polytechnic Inst.). Ukr. Khim. Zh.; 39: No. 9, 946-947(Sep 1973). (In Russian).

Infrared spectra of titanium oxides (TiO, Ti_2O_3, and TiO_2) and of zirconium and hafnium dioxides were recorded and analyzed. (tr-auth)

7540 CHEMICAL SPECTRAL METHOD FOR ANALYSIS OF HIGH-PURITY SILVER USING DI-n-OCTYLSULFIDE EXTRACTION OF THE MATRIX. Vail, G. A.; Shatskaya, S. S.; Yudelevich, I. G.; Torgov, V. G. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 5, 88-92(Sep 1973). (In Russian).

Chemical spectral method for analysis of high-purity silver using di-n-octylsulfide extraction of the matrix was developed. Twenty-two elements including Mo, Be, and Te were determined by this method with detection limit $n \cdot 10^{-6}$ to 10^{-4}% and variation coefficient of 7 to 25%. (auth)

7541 QUANTITATIVE ANALYSIS OF MULTI-LAYER ABSORBERS BY MOESSBAUER TRANSMISSION SPECTROMETRY. Bainbridge, J. (Central Electricity Research Labs., Leatherhead, Eng.). Nucl. Instrum. Methods; 112: No. 3, 495-499(1973).

A specimen composed of a number of phases distributed in layers gives a Moessbauer spectrum which is the sum of the individual patterns characteristic of each phase. The relation between the relative intensity of each Moessbauer pattern and the individual layer thicknesses is examined. The theory is applicable to any composite multi-layer absorber but will probably find most application in the quantitative analysis of spectra from oxidized metal foils. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 7729, 7767, 7770, 7773, 7801, 7810, 7812, 8077, and 8177.

7542 (EURFNR-1099) BURNUP DETERMINATION ON NUCLEAR FUEL SAMPLES FROM THE FR-2 REACTOR. Hoffmann, H.; Wertenbach, H. (Kernforschungszentrum Karlsruhe (F.R. Germany)). Apr 1973. 91p. (KFK-1704). Dep. NTIS $6.75.

Work performed under United States-Euratom Fast Reactor Exchange Program.

A survey is presented of the methods of determining the burnup of enriched fuel (UO_2, max. 12.5% ^{235}U). The pins were irradiated in the FR2 reactor up to a burnup of 90,000 MWd/t heavy atoms. Including a discussion of errors the following types of burnup determination are treated: γ-spectrometric method; this is the radiochemical calibration of a γ-scan; neutron physics method with Co-detectors; radiochemical methods founded on measuring the activity of ^{90}Sr, ^{106}Ru, ^{137}Cs, ^{144}Ce, ^{148}Nd (after neutron activation) and the concentration of ^{99}Tc photometrically; mass spectrometrical determination of ^{148}Nd and of the composition of the uranium isotopes; and calorimetric methods including measurements of temperature and quantity of coolant and on the other hand, measurements of the temperature with thermocouples in the capsules. The radiochemical methods showed that ^{137}Cs and ^{99}Tc are not suitable as burnup detectors because of their tendency to migrate. The ^{144}Ce method was directly compared with the calorimetric method for irradiated samples from capsule group No. 3. The discrepancies were explained as irradiation damage of the thermocouples and seasonal deviations of the D_2O temperature of the reactor FR2. Both methods show uncertainties of the same magnitude (5 to 6%). (auth)

7543 RADIOCHEMICAL SEPARATION METHODS. Ghersini, G. (CISE, Milan). Energ. Nucl. (Milan); 20: No. 8-9, 461-466(1973). (In Italian).

From seventh radiochemical conference on radiochemical separation methods; Marianske Lazne, Czech (24 Apr 1973).

A survey is made of the papers presented at the 7th Radiochemical Conference held on April 24-27, 1973, and mainly devoted to the methods for radiochemical separations. The great majority of papers concerned unpublished works on theoretical aspects or practical applications of solvent extraction, extraction chromatography, and ion-exchange chromatography with inorganic or organic-based materials. Several papers were also devoted to other separation techniques, and to direct radioanalytical methods. (auth)

7544 SUMMARY OF THE STATE OF THE ART IN RADIOCHROMATOGRAPHY. Prydz, S. (Univ. of Oslo). Anal. Chem.; 45: No. 14, 2317-2326(Dec 1973).

Film registration in radiochromatography is discussed. Low-temperature fluorography gives the lowest detection limits, 3.0 and 0.06 $nCi \cdot day/cm^2$ for tritium and radiocarbon, respectively. Various detectors for one- and two-dimensional scanning, comprising windowless gas-flow GM detectors, solid state detectors, and vacuum-operated channel electron multipliers are treated. The luminescence detection method, applying scintillators in the chromatogram and a scanned photon detector, is discussed. For tritium, the latter method is about 30 times more efficient than GM detection. Two radio-labels may be counted simultaneously using pulse height discrimination. The beta camera, the spark chamber, and the possibility of using image intensifiers are also discussed. The application of a computer to increase the signal-to-noise ratio and, hence the sensitivity, of scanners is mentioned. A comparison of the sensitivities of the available detection techniques and an appendix giving prices and technical details of the commercially available scanners are given. (auth)

7545 NONDISPERSIVE X-RAY FLUORESCENCE IN THE STUDY OF RAPID RADIOCHEMICAL SEPARATION OF SELENIUM FROM ARSENIC: GERMANIUM, AND ZINC. LaBrecque, J. J.; Kulkarni, P. V.; Preiss, I. L. (Rensselaer Polytechnic Inst., Troy, NY). J. Radioanal. Chem.; 14: No. 2, 455-460(Apr 1973).

A rapid radiochemical separation of selenium from arsenic, germanium, and zinc based on the precipitation of elemental selenium by $NaHSO_3$ is discussed. Yields of 90% and greater are achieved from selenium in 1 to 2 min. The kinetics, separation characteristics of the process, and chemical yield of Se and trace contaminants such as Zn, Ge, and As were studied using nondispersive x-ray fluorescence techniques. (auth)

7546 APPEARANCE OF SYMMETRIC TELLURIUM AND DISELENIUM DISULFONATES IN THE COURSE OF DECOMPOSITION OF TELLURITES WITH SELENOTRITHIONATES. Blasius, E.; Knoechel, A. (Univ. of Saarland, Saarbruecken, Ger.). J. Radioanal. Chem.; 14: No. 2, 335-342(Apr 1973). (In German).

Reduction of TeO_3^{2-} by $SeS_2O_6^{2-}$ in acidic solution gives a black mixture of Se and Te. Intermediary products are $SeSO_3^{2-}$; $[O_3S-Se-Te-Se-SO_3]^{2-}$ and Selenandisulfonates, containing 1-4 Se-atoms in the chain. The anions are separated by high voltage paper electrophoresis and identified radiochemically, using ^{35}S-, ^{75}Se- and ^{132}Te-labelled reactants of detected specific activity. For the formation of the anions the reduction of TeO_3^{2-} by $SeSO_3^{2-}$ is discussed. (auth)

7547 STUDY OF RETENTION PROPERTIES OF THE INORGANIC FILTER PbS IN CONNECTION WITH ITS APPLICATIONS IN ANALYTICAL RADIOCHEMISTRY. Guillaume, M. (Univ., Liege). J. Radioanal. Chem.; 14: No. 2, 239-254(Apr 1973). (In French).

The fixation behavior of PbS specially prepared for analytical purposes has been studied using batch equilibration technique and chromatographic columns. This inorganic adsorbant shows a high and specific fixation capacity for ions such as Cu^{2+} Hg^{2+}, Br^-, SeO_3^{2-}. An interpretation of the fixation mechanism is proposed. (auth)

7548 STANDARD METHODS FOR RADIOCHEMICAL DETERMINATION OF CESIUM-137 IN NUCLEAR FUEL SOLUTIONS. 1973 Annual Book of ASTM Standards. Part 30. Philadelphia; American Society for Testing and Materials (1973). 6p. (ASTM-E-320-70).

Two methods are used for the quantitative determination of radioactive ^{137}Cs in a known quantity of aqueous solution. They are designed for solutions that result from the dissolution of irradiated nuclear fuel primarily for determining burnup. The atom percent fission in uranium fuel may be calculated from the quantity of ^{137}Cs. These methods are applicable to any solution of dissolved nuclear fuel containing sufficient ^{137}Cs for accurate counting provided that at least 130 days cooling time is allowed for the decay of ^{86}Rb and ^{136}Cs. The perchlorate method is based on the separation of cesium by precipitation as cesium perchlorate from a solution of ethyl alcohol and perchloric acid. Natural cesium chloride (or nitrate) is added as a carrier to minimize adsorption of ^{137}Cs on surfaces and to provide weighable quantities of cesium for determining the chemical recovery. An initial precipitate of cesium perchlorate is formed and dissolved. For further purification, two ferric hydroxide scavenging steps follow. A final precipitation of cesium perchlorate converts the cesium to a form suitable for weighing and for radioassay. The chloroplatinate method is based on the separation of cesium by precipitation as cesium chloroplatinate from a hydrochloric acid-ethyl alcohol medium. Natural cesium chloride (or nitrate) is added as a carrier to minimize adsorption of ^{137}Cs on surfaces and to provide weighable quantities of cesium for determining the chemical recovery. As initial purification, two ferric hydroxide scavenging steps are used. A final precipitation of cesium chloroplatinate converts the cesium to a form suitable for weighing and for radioassay. (auth)

7549 SELECTIVE MICROSCALE X-RAY FLUORESCENCE ANALYZING METHOD FOR DETERMINATION OF TRACE ELEMENTS. Puumalainen, P.; Suominen, P.; Hattula, J.; Kalm, H. (Jyvaeskylae Univ., Finland). Int. J. Appl. Radiat. Isotop.; 24: No. 11, 617-620(Nov 1973).

A new selective x-ray fluorescence analyzing method for trace element determination has been developed. In this method each trace element is measured independently. The excitation source is an x-ray tube that has a changeable anode and a variable high voltage. The exciting radiation is shaped with critical absorbers. The sample is viewed at backward angles through an absorber to reduce backscattered radiation. The estimated accuracy of this method is of the order of 10% in the sub-ppM range of trace element concentration in organic samples. Measurement times are of the order of a few minutes. (auth)

7550 TRACE ANALYSIS BY CONCENTRATION ON ION EXCHANGE PAPER AND X-RAY RADIOISOTOPIC FLUORESCENCE. Robert, A.; Valles, R. (CEN de Saclay, Gif-sur-Yvette, France). Radiochem. Radioanal. Lett.; 15: No. 4-5, 279-289(20 Nov 1973). (In French).

The method of concentration on ion exchange resin loaded paper was applied for preparation of sample for x-ray radioactive fluorescence analysis. Some examples are described for the elements Ca, Ba, Pb, U in aqueous solution. The limits of detection for these elements and a practical method of preparation are about 10^{-1} ppM. (auth)

7551 PROCESS FOR NONDESTRUCTIVE DETERMINATION OF BURNUP OF FUEL ELEMENTS OR BREEDER ELEMENTS. Munch, E. (to Kernforschungsanlage Juelich GmbH, German).

A process is proposed for the nondestructive determination of the burnup of fuel elements and/or breeder elements by measuring the intensity of radioactive radiation and especially the intensity of the gamma radiation emitted. The process is characterized by the fact that one adds to the nuclear fuel and/or to the fertile material or to the material serving as the casing, before introducing it into the reactor, some isotopes or mixtures of isotopes that can be activated. The activity of the isotope or mixture of isotopes added is measured after irradiations in the reactor. (TSS)

Separation Procedures

Refer also to abstracts 7569 and 9065.

7552 EQUILIBRIUM IN THE EXCHANGE OF UNIVALENT IONS ON SYNTHETIC MORDENITE. Grivkova, A. L.; Zaitsev, B. A. (Inst. of Physical Chemistry, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 4, 538-540(Apr 1973).

Translated from Zh. Fiz. Khim.; 47: No. 4, 952-955(Apr 1973).

Equilibrium in the exchange of Cs^+ ions on the Na, NH_4^+, K^-, and Rb-forms of synthetic mordenite was investigated. The total exchange capacity of the test specimens with respect to the Cs^+ ion is 1.3 to 1.5 mequiv. g^{-1}. The thermodynamic exchange constants and the ionic activity coefficients in mordenite have been determined by the method of Gaines and Thomas. Synthetic mordenite exhibits a much higher separating capacity in relation to the univalent ions investigated than NaA zeolite. (auth)

7553 SELECTIVE CHROMATOGRAPHIC SEPARATION OF URANIUM(VI) ON DEAE-CELLULOSE LAYERS IN DILUTE ACETIC ACID MEDIA. Kuroda, R.; Oguma, K.; Watanabe, H. (Chiba Univ., Japan). J. Chromatogr.; 86: No. 1, 167-172(7 Nov 1973).

In dilute acetic acid solutions, U(VI) shows a useful chromatographic distribution on DEAE-cellulose layers, while most other metal ions migrate upwards to the solvent front or remain at or near the start. This chromatographic behavior of U(VI) enables a selective method for the separation of U(VI) by thin-layer chromatography to be developed. The R_F values on DEAE-cellulose and Avicel SF are quoted for 34 metal ions as a function of acetic acid concentration in the range 1-6*M*. Results for two- and three-component separations by elution with 1 *M* acetic acid are given in order to illustrate the effectiveness and utility of the present method. (auth)

7554 SOLVENT EXTRACTION BEHAVIOR OF TRACER ZIRCONIUM IN TTA-XYLENE SYSTEM. Erten, H. N. (Middle East Technical Univ., Ankara). J. Radioanal. Chem.; 14: No. 2, 343-349(Apr 1973).

The solvent extraction behavior of tracer zirconium in the TTA-xylene system has been studied. By studying the effect of TTA concentration, extraction time, and acid concentration for HNO_3 and HCl, optimum conditions of zirconium extraction are determined. It is found that zirconium is 98% extracted in one minute of extraction with 0.5M TTA in xylene from an 8M HNO_3 solution. A plot of lg D versus lg [TTA] gives a straight line with a slope of 2. This suggests that the zirconium ion is hydrolyzed and is present as ZrO^{2+}, zirconyl ion, in aqueous solutions. (auth)

7555 SORPTION OF ^{144}Ce(III) AND ^{147}Pm(III) ON HYDRATED IRON SESQUIOXIDE. Kepak, F.; Nuderova, M.; Kanka, J. (Inst. of Nuclear Research, Rez, Czech.). J. Radioanal. Chem.; 14: No. 2, 325-333(Apr 1973).

The sorption of ^{144}Ce(III) and of ^{147}Pm(III) on hydrated iron sesquioxide suspension and the sorption of ^{144}Ce(III) on hydrated iron sesquioxide in a laboratory column were studied. The dependence of the sorption on pH and time, the sorption isotherm, the temperature-dependence of sorption, and the effects of ionic strength on sorption and desorption were determined under static conditions. The maximum sorptions of ^{144}Ce(III) and ^{147}Pm(III)

were reached at pH = 7.4 ($K_d = 8.9 \cdot 10^5$) and pH = 9.1 ($K_d = 6.2 \cdot 10^5$), respectively. (auth)

7556 SEPARATION OF RARE-EARTH FISSION PRODUCT ELEMENTS FROM ^{106}Ru AND ^{137}Cs BY CHLORIDE SUBLIMATION. Davidov, A. V.; Travnikov, S. S.; Myasoedov, B. F. (Inst. of Geochemistry and Analytical Chemistry, Moscow). J. Radioanal. Chem.; 14: No. 2, 285-293(Apr 1973).

The possibility has been investigated of separating rare earth fission fragment elements from ^{106}Ru and ^{137}Cs by high-temperature sublimation (950°C) of chlorides, with their subsequent gas adsorption separation in a quartz tube under a temperature gradient in a flow of the carrier-gas Ar + $SOCl_2$. The temperatures corresponding to the maxima of the element precipitation zones are: 630-660°C (^{144}Ce), 770-780°C (0.7-6 μg ^{140}La + La), 920°C (1.5 mg Ce or La), 420-450°C (^{106}Ru), 280-300°C (^{137}Cs). The coefficients of element separation have been calculated. For the separation of indicator amounts of rare earth elements and ^{106}Ru and ^{137}Cs, fractional sublimation of the chlorides of the latter at 650°C has been used. Rate constants and effective activation energies of the overall processes of chlorination-sublimation of the elements have been determined. (auth)

7557 ADSORPTION PROPERTIES OF INSOLUBLE HEXACYANOFERRATES(II) SUPPORTED ON SILICA GEL. Konecny, C.; Caletka, R. (Inst. of Nuclear Research, Rez, Czech.). J. Radioanal. Chem.; 14: No. 2, 255-266(Apr 1973).

A novel method of preparation of inorganic ion-exchangers based on insoluble hexacyanoferrates(II) supported on silica gel, their characteristics, and application to recovery of cesium from dilute nitric acid are described. (auth)

7558 DEVELOPMENT OF RAPID SEPARATIONS OF TRANSACTINIDE ELEMENTS FROM AQUEOUS SOLUTIONS. Trautmann, N.; Dittner, P.; Franz, G.; Herrmann, G.; Kaffrell, N.; Tittel, G. (Univ., Mainz). (1973). vp.

From 24th IUPAC congress; Hamburg, Germany (2 Sep 1973).

Fully automated chemical separation processes for the separation of the transactinide 104-108 homologues Zr, Nb, Mo, Tc, and Ru from the products of ^{235}U, ^{239}Pu, and ^{249}Cf fission are briefly described. These procedures permit, within a few seconds, the selective isolation of the above-mentioned elements from fission product mixtures containing more than 30 other elements. (GE)

7559 SEPARATION OF TRACE ELEMENTS BY PRECIPITATION. X. Sorption of Th^{4+}, Zr^{4+}, and Hf^{4+} on $Fe(OH)_3$ from Na_2CO_3 Solution. Upor, E.; Nagy, G. (Mecseki Mining Corp., Pecs, Hungary). Acta Chim. Acad. Sci. Hung.; 78: No. 1, 47-55(1973).

A study was made of the sorption of Th^{4+}, Zr^{4+}, and Hf^{4+} on $Fe(OH)_3$ from Na_2CO_3 solutions. It was found that there is a minimum in the sorption at pH 9 - 10. The relative stabilities of the carbonato complexes give the following order: $Ln^{3+} < Sc^{3+} < Th^{4+} < Hf^{4+} < Zr^{4+} < UO_2^{2+}$. It was established by a logarithmic method that the CO_3^{2-} : M^{4+} ratio for the complex in solution is 3 for Zr^{4+} and 4 for Hf^{4+} and Th^{4+}. Data are reported on the possibilities of separating individual ions that form carbonato complexes, both from each other and from $Fe(OH)_3$. (auth)

7560 EXTRACTION OF NIOBIUM COMPLEX WITH PYROCATECHOL VIOLET IN THE PRESENCE OF PYRIDINE AND TRICHLOROACETIC ACID. Tananaiko, M. M.; Vdovenko, O. P.; Shevchuk, V. V. (Kiev State Univ.). Ukr. Khim. Zh.; 39: No. 9, 939-942(Sep 1973). (In Russian).

Spectroscopic studies of the Nb(V) complex with pyrocatechol violet (PV) in the presence of pyridine (Py) and trichloroacetic acid (TCA) showed the formation of an isobutanol-extractable complex, Nb : PV : Py : TCA = 2 : 1 : 1 : 3, an association of the complex OH_2PVPyH^{3+} with the TCA anion. The possibility was demonstrated of using the quaternary complex for extraction-photometric determination of niobium with a sensitivity to 2 μg in 25 ml of extract. (tr-auth)

7561 EXTRACTION OF PLATINUM METALS BY DIPHENYLTHIOUREA. Shulman, V. M.; Kosareva, L. A. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 5, 137-139(Sep 1973). (In Russian).

The distribution coefficients of platinum metals were studied using diphenylthiourea with chloroform. Pd (II) and Ru (IV) are completely extracted after heating their solution up to 60°C, but for Rh (III), Pt (IV), and Ir (IV), preliminary heating to 100-130°C is needed. (auth)

7562 UNIVERSAL LABORATORY EXTRACTOR WORKING CONTINUOUSLY. Gawlowska, W. (Instytutu Badan Jadrowych, Warsaw). Nukleonika; 18: No. 8, 361-368(1973). (In Polish).

The experimental investigation on a model of a laboratory continuous mixer-settler extractor with gravitational phase separation was carried out in an extraction of uranyl nitrate with 30% tri-n-butyl phosphate, the maximum yield of uranium extraction was 30 ml/min for both phases. The results show 100% extraction efficiency in a full range of flow. An apparatus version especially designed for metals extraction from high radioactive solutions was characterized. (auth)

7563 BASIC CHARACTERISTICS AND ANALYSIS OF THE HYDRODYNAMICAL STRUCTURE OF FLOWS IN PULSED SORPTION COLUMNS. Karpacheva, S. M.; Koshkin, V. N.; Zakharov, E. I. (State Committee on the Use of Atomic Energy, Moscow). Kernenergie; 16: No. 8, 249-252(Aug 1973). (In Russian).

After having described the function of pulsed sorption columns their basic characteristics are given and discussed when applied to some hydrometallurgical processes. The economy of their use for "fast" processes was verified by comparing them with counter-current sorption columns in the extraction of rare earth elements. The limits of applying the single-parameter diffusion model to the description of the hydrodynamical structure of column flows were determined. The theoretical results obtained on a digital computer are compared with experimental data obtained with the system solution of rare earth elements-cation exchanger KU-2-8. (auth)

7564 METHOD FOR THE EXTRACTION OF ZIRCONIUM FROM ZIRCONIUM-CONTAINING MATERIALS. Markland, S. A. (to Atomenergikommissionen). Danish Patent 0081/72. 8 Oct 1973. Filed date 7 Jan 1972. (In Danish).

The method described involves the isolation of zirconium from impurities in an aqueous acid solution by extraction with an amine. The zirconium-amine compound is treated further with a view to extraction or/and conversion into another zirconium compound, principally zirconium dioxide or zirconium metal, the extraction with amine being made in the presence of hydrogen peroxide. (DE)

Inorganic, Organic, and Physical Chemistry

Refer also to abstract 8373.

Chemical and Physicochemical Properties

Refer also to abstracts 7606, 7608, 8008-8010, 8190, 8197, 8210, 8216, 8237, 8305, 8643-8645, 9663, 9681, 9691, 9698, and 9701.

7565 COMPARISON OF THE BEHAVIOR OF CERTAIN FRESHLY FORMED MICROCRYSTALLINE SOLIDS TOWARDS ADSORPTION OF TRACER PHOSPHATE IONS. Bhutani, M. M. (Indian Inst. of Tech., New Delhi). J. Radioanal. Chem.; 14: No. 2, 229-237(Apr 1973).

The deposition of carrier-free orthophosphate ions on freshly precipitated microcrystalline sulfates has been studied. The results indicate a significant influence of various factors, e.g., the pH of the suspension medium, the concentration of lattice and certain non-lattice ions, the age of the precipitate and the time of contact of the tracer with the carrier surface. The carrying is considered in the light of surface adsorption. The role of non-lattice cations and the relative merits of freshly precipitated $SrSO_4$, $BaSO_4$, and $PbSO_4$ as carrier for phosphate tracer, are discussed. Though they show better efficiency as carriers, because of poor recovery they are of limited applicability for quantitative concentration of traces of phosphate. (auth)

7566 INORGANIC CHEMISTRY OF THE TRANSITION ELEMENTS. Volume 2. Review of the Literature Published Between October 1971 and September 1972. Johnson, B. F. G. (ed.). Specialist Periodical Report. London; Chemical Society (1973). 480p.

The review is in four chapters entitled: the early transition metals (titanium, zirconium and hafnium, vanadium, niobium and tantalum, chromium, molybdenum and tungsten, technetium and rhenium); elements of the first transitional period (manganese, iron, cobalt, nickel, copper, ligands, formation and stability constants); the noble metals (ruthenium, osmium, rhodium, iridium, palladium, platinum, silver, gold); the lanthanides (including scandium and yttrium) and the actinides. The section on technetium and rhenium and the section on the actinides are in NSA scope, and separate abstracts were prepared for the two of them. (UK)

For abstracts of individual chapters see: 7607 and 7608.

7567 LOW-TEMPERATURE REDUCTION OF MOLYBDENUM AND TUNGSTEN OXIDES. Uvarova, I. V.; Panichkina, V. V.; Konchakovskaya, L. D. Izv. Akad. Nauk SSSR, Metal.; No. 4, 86-91(1972). (In Russian).

Kinetic data on reduction of MoO_3 and WO_3 and x-ray phase analyses of the intermediate phases were found to agree with the results of thermodynamic calculations for the reduction of

oxides of these metals. The catalytically active addition of Pt decreased the temperature of reduction of MoO_3 but did not affect that of WO_3. In the low-temperature reduction of WO_3, the intermediate WO_2 and W_3O phases were absent. (tr-auth)

7568 EARLY TRANSITION METALS. Kepert, D. L. London; Academic Press (1972). 499p.

The first chapter covers the features characteristic of the early transition metals. Particular emphasis is placed on high co-ordination numbers (stereochemistry, adducts, complexes, chelates and ligands), metal-metal bonding (crystal lattices), and isopoly- and heteropolyanions. Each of the remaining three chapters deals with one of the groups of the early transition metals (group IV–titanium, zirconium, hafnium; group V–vanadium, niobium, tantalum; group VI–chromium, molybdenum, tungsten). An extensive list of references is included. (UK)

7569 SYNTHESIS AND STUDY OF POLYMERIC COMPLEX-FORMING AGENTS WITH AMINOETHYLPHOSPHONIC ACID GROUPS. Davankov, A. B.; Leykin, Yu. A.; Rataychak, V.; Korshak, V. V. (Moscow Chemico-Technological Inst.). Vysokomol. Soedin.; 15: No. 6, 1203-1214(Jun 1973). (In Russian).

A macroporous chloromethylated styrene-divinylbenzene copolymer with 20% divinylbenzene that contained 17.7-18.2% Cl was aminated with N,N-dialkyl-beta-aminoethylphosphonic acid diethyl esters $R_2N(CH_2)_2P(O)\cdot(OEt)_2$ (I; R = Me, Et). At high temperatures and in polar solvents, conversion of the initially introduced diester groups to monoester groups took place by the mechanism $-CH_2^+NR_2 - (CH_2)_2^{Cl^-} - P(O)(OEt)_2 \xrightarrow{-RCl} -CH_2NR_2(CH_2)_2\cdot P(O)\langle^{OEt}_{O^-}$ Amination with I(R = Me) proceeded more effectively and with a higher yield than that with I(R = Et). In a side reaction, monoester groups that had been introduced into the copolymer reacted with chloromethyl groups under formation of phosphonic acid benzyl esters that contained a readily hydrolyzable C-O-P link. Tests with the aminated copolymer that contained monoester groups and was obtained upon the reaction with I(R = Me) showed that the product of this reaction acted as a selective chelating agent adsorbing preferentially UO_2^{2+} cations from HNO_3 solutions in the presence of Ca^{2+}, Co^{2+}, and Fe^{3+}. (JPRS)

7570 PREPARATION OF PURE ZrO_2 FROM INDUSTRIAL SOLUTIONS. Kolenkova, M. A.; Sazhina, V. A.; Segal, I. M. Tsvetn. Metal.; No. 6, 50-52(Jun 1973). (In Russian).

Pure ZrO_2 may be prepared by concentration and crystallization of ZrO_3; solid phase salting out of zirconium disulfate acid hydrate (ZDAH) from basic zirconium sulfate; or direct salting out of ZDAH from the sulfate solution obtained in hydrochloric–sulfuric acid leaching. In the last method, in which concentrated ZrO_2 solutions are used, acid consumption is lower, ZrO_2 recovery is higher, and process stages are fewer than in other methods. (tr-auth)

7571 SECOND VIRIAL COEFFICIENT FOR HEAVY WATER. Gupta, R. N.; Jain, P. C.; Nanda, V. S. (Univ. of Delhi). Indian J. Pure Appl. Phys.; 11: No. 5, 308-309(May 1973).

Calculations of the second virial coefficient for heavy water were made using the P–T data along the saturation line in the temperature range 70 to 160°C. These values were found to be consistently lower than those for ordinary water. The validity of the principle of corresponding states with respect to the second virial coefficient values has been considered. (auth)

Isotope Effects

Refer also to abstracts 7585 and 7616.

7572 (COO-3581-1) STABLE ISOTOPE STUDIES. Progress Report, July 1, 1971–July 31, 1973. Spindel, W. (Yeshiva Univ., New York (USA). Belfer Graduate School of Science). 31 July 1973. 31p. Dep. NTIS $3.75.

Research is reported on stable isotope studies including a section on studies on ^{13}C fractionation in chemical exchange and distillation of phosgene and a study the purpose of which was the development of an auxiliary method for determining force fields of molecules using thermodynamic data such as isotope exchange equilibrium constants or vapor pressure isotope effects in place of spectroscopic data. (DHM)

7573 DEUTERIUM ISOTOPE EFFECTS AND CHEMICALLY MODIFIED COENZYMES AS MECHANISM PROBES OF YEAST GLYOXALASE-I. Vander Jagt, D. L.; Han, L. P. B. (Univ. of New Mexico, Albuquerque). Biochemistry; 12: No. 25, 5161-5167(4 Dec 1973).

The previously reported observation that the rates of disproportionation of the hemimercaptals of glutathione and substituted phenylglyoxals, catalyzed by yeast glyoxalase-I, are insensitive to substituents raised the question of whether or not the intramolecular hydride migration step is rate determining. This question was investigated using deuterated α-ketoaldehydes. The disproportionation of methylglyoxal and perdeuteriomethylglyoxal shows an isotope effect on $V_{max}(V_{max,H}/V_{max,D} = 2.9)$. This is comparable to the isotope effect observed in the hydroxide ion catalyzed disproportionation of methylglyoxal and perdeuteriomethylglyoxal, $k_H/k_D = 3.8$. Likewise, the glyoxalase-I-catalyzed disproportionation of phenylglyoxal and α-deuteriophenylglyoxal shows an isotope effect ($V_{max,H}/V_{max,D} = 3.2$) comparable to the hydroxide reaction ($k_H/k_D = 5.0$), leading to the conclusion that hydride migration is the rate-determining step for the glyoxalase-I reaction. For both pairs of α-ketoaldehydes, this isotope effect is also reflected in K_M, suggesting that the catalytic rate constant (k_3) is larger than the rate constant for dissociation of the enzyme–substrate complex (k_2) and that $K_M \simeq k_2/k_1$. Using purified preparations of glyoxalase-I, k_1 and k_2 were determined. The coenzyme role of glutathione in the glyoxalase-I reaction was evaluated using pH-rate profiles and chemically modified coenzymes. In the pH range 4.5–9, V_{max} shows no pH sensitivity; K_M values, however, increase at high and low pH suggesting that dissociable groups of pK values of about 5 and 8.5 are involved in binding the substrate to the enzyme. These apparent pK values are sensitive to the apolar character of the α-ketoaldehydes. V_{max} values are not affected if N-acetylglutathione is used in place of glutathione. K_M values, however, increase. Methylation of the glycyl residue of glutathione prevents binding of the hemimercaptals to the enzyme. Thus, the dissociable groups on glutathione appear to be involved primarily in enzyme–substrate formation rather than in the catalytic reaction. (auth)

7574 EXCESS GIBBS ENERGIES OF MIXING OF SOLUTIONS OF LITHIUM CHLORIDE AND CESIUM CHLORIDE IN WATER AND IN DEUTERIUM OXIDE. Robinson, R. A. (State Univ. of New York, Binghamton). J. Chem. Thermodyn.; 5: No. 6, 819-827(Nov 1973).

From first middle Atlantic regional meeting, American Chemical Society; Newark, DE (2 Apr 1970).

Isopiestic vapor pressure measurements of LiCl solutions and of CsCl solutions in D_2O have been made and the osmotic coefficients derived therefrom are compared with those in H_2O as solvent. Similar measurements on mixtures of LiCl and CsCl in H_2O and in D_2O have also been made and used to calculate excess Gibbs energies of mixing in these two solvents. (auth)

7575 NEIGHBORING GROUP PARTICIPATION IN SOLVOLYSIS. V. Carbon-14 and Deuterium Isotope Effects in Solvolysis of Neophyl p-Bromobenzenesulfonate. Yamataka, H.; Kim, S. G.; Ando, T.; Yukawa, Y. (Osaka Univ.). Tetrahedron Lett.; No. 48, 4767-4770(Nov 1973).

In previous publications [Yukawa et al., Tetrahedron Lett.; 2367 (1969), 847 (1971) and 373 (1973)] it was reported that the magnitude of the ^{14}C isotope effect at the phenyl-1 position observed in solvolysis of neophyl p-bromobenzenesulfonate $C_6H_5-\overset{CH_3}{\underset{CH_3}{C}}\beta-C_6L_2OSO_2C_6H_4Br-p$ (L = H) was similar to those of 2-arylethyl nosylates proceeding exclusively with participation by a neighbouring aryl group. The kinetic isotope effects at various other positions have now been measured. Labeled esters were prepared with $\alpha-{}^{14}C$, L = H; $\beta-{}^{14}C$, L = H; and L = D respectively. Acetolysis was followed titrimetrically and trifluoroacetolysis was done spectrophotometrically. Experimental details are given and results are reported and discussed. (UK)

Isotope Exchange and Isotope Separation

Refer also to abstract 8146.

7576 DEUTERIUM EXCHANGE IN ALKYLPYRIDINES. Parham, W. E.; Olson, P. E. (Duke Univ., Durham, NC). Tetrahedron Lett.; No. 48, 4783-4786(Nov 1973).

In experiments designed to elucidate the stereochemical course of reduction occurring during the solvolysis of an alkylquinoline compound in formic acid, it was observed that all benzylic hydrogen atoms were completely exchanged by deuterium when the compound was heated in formic acid-d_2. While it is well known that benzylic hydrogen atoms in the 2- and/or 4-position of the pyridine (and related) ring systems undergo deuterium exchange readily in alkaline medium, there have been no previous reports of such exchange in organic acids. In initial studies it was observed that alkylpyridines do not undergo deuterium exchange in D_2O containing excess DCl. It was found, however, that exchange occurred readily at the 2- and 4-benzylic positions in alkylpyridines in deuterioacetic acid. Hydrogen chloride in acetic acid, in contrast to hydrogen chloride in water, did not prevent exchange. Exchange also took place, though quite slowly, in 2-alkylpyridines in boiling deu-

terium oxide. Experimental details are presented and results are discussed. (UK)

Feed Materials Processing

Refer also to abstract 7654.

7577 (JEN-273) ISOLATION AND CHARACTERIZATION OF BACTERIA IN THE DRAINAGE WATER FROM THE RATONES MINE AND ITS BEHAVIOR ON PYRITE. Merino, J. L.; Saez, R. M. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 37p. (In Spanish). Dep. NTIS (U. S. Sales Only) $4.00.

Some of the studies made on iron-and sulfur-oxidizing bacteria in the drainage water from Ratones mine are described. Some experiments were also made on pyrite aimed at determining the possibility of applying the bacteria to the leaching of pyrite and subsequently to the leaching of uranium ores. (auth)

Radiation Chemistry

Refer also to abstracts 7621, 7884, 7902, and 8376.

7578 (COO-2086-52) RADIOLYSIS STUDIES ON REACTIVE INTERMEDIATES. Technical Progress Report, April 1, 1972–November 1, 1973. Kevan, L. (Wayne State Univ., Detroit, Mich. (USA). Dept. of Chemistry). [nd]. Contract AT(11-1)-2086. 24p. Dep. NTIS $3.25.

Progress of research in radiation chemistry is reported. The research covers pulsed EPR set-up for spin-lattice relaxation studies, measurement of the quasi-free electron state in disordered systems, thermal decay kinetics in gamma-irradiated systems, and polarized recombination luminescence studies. Abstracts of 21 papers that have been published or accepted for publication are included. Titles of scientific talks presented and Ph. D. theses completed are listed. (LK)

7579 (KFK-EXT-10/73-1) RADIOLYSIS OF LIQUID AMMONIA IN THE PRESENCE OF ISOPROPYLALCOHOL. Dessouki, A. M. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Radiochemie). Sep 1973. 77p. (In German). Dep. NTIS (U. S. Sales Only) $6.00.

The effects of variation of dose on the various yields resulting from γ-irradiation of liquid ammonia and ammoniacal solutions containing isopropanol and N_2O, NH_4Cl, $NaNO_3$, CH_3I, Fe (III) or benzophenone were investigated. The G-Values of the primary products resulting from the γ-radiolysis of ammoniacal solutions containing isopropanol are reported. The G-value of the free electron was calculated and found to be 2.1. Additionally ammonia/isopropanol-d_7 solutions were investigated. (auth)

7580 (RRL-3238-457) QUARTERLY REPORT, JULY 1–SEPTEMBER 30, 1973. (Mellon Inst. of Science, Pittsburgh (USA). Radiation Research Labs.). 5 Oct 1973. Contract AT(11-1)-3238. 21p. Dep. NTIS $3.25.

Abstracts of reports issued during the report period are presented. Brief summaries are given of investigations in progress that include time resolved ESR studies; ESR study of proton exchange reactions in some hydroxycyclohexadienyl radicals; an ESR study of some cyclic oxocarbon radicals; solvent effects on ESR spectra of ascorbic acid radicals; radiation chemical studies on aqueous solutions of α-bromotetronic acid; application of liquid chromatography techniques to studies of radiation chemistry in micelles; ionic processes in the radiolysis of hydrocarbons; radiation chemistry of bile salts; and micellar effects on excited singlet states. (DHM)

7581 EFFECT OF IRRADIATION ON THE PROPERTIES OF VULCANIZED BUTYL RUBBER. Zurakowska-Orszagh, J.; Nowak, Z. (Univ., Warsaw). Polim. Tworzywa; 17: 376-381 (1972).

The effect of gamma irradiation on some properties of vulcanized butyl rubber was determined, in particular the degree of equilibrium swelling, in relation to the type and amount of antipinenes introduced to the composition. (auth)

7582 EFFECT OF CONTENT OF DIVINYLBENZENE IN KU-2 CATION-EXCHANGE RESIN ON ITS RESISTANCE TO IRRADIATION IN WATER. Tulupov, P. E.; Butaev, A. M.; Greben, V. P.; Kasperovich, A. I. Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 4, 551-553(Apr 1973).

Translated from Zh. Fiz. Khim.; 47: No. 4, 975-979(Apr 1973).

Changing the divinylbenzene content of the sulphonated polystyrene cation exchanger KU-2 from 8% to 24% has hardly any effect on the stability of the sulpho-groups. It is incorrect to use relative loss in exchange capacity as a criterion of the stability of ion-exchange materials. Structural changes in the exchanger matrix during irradiation are discussed. (auth)

7583 ESR OF HOT IONS: Ni(I) COMPLEX IONS PRODUCED IN Ni(II) COMPLEXES BY γ-IRRADIATION. Amano, C.; Watanabe, T.; Fujiwara, S. (Tokyo Univ.). Bull. Chem. Soc. Jap.; 46: No. 8, 2586-2587(Aug 1973).

Nickel(II) chloride hexahydrate was the starting material for synthesis of 46 Ni(II) complexes. These complexes were gamma irradiated at room temperature and then studied by ESR. (LK)

7584 INVESTIGATION ON RADIO-INDUCED CHANGES OF N-ACETYL-DL-VALINE. Schnepel, G. H. (Univ., Giessen, Ger.). (1973). vp. (In German).

From Annual meeting of the Deutsche Gesellschaft fuer biophysik; Juelich, Germany (27 Sep 1973).

Single crystals of N-acetyl-DL-valine of unknown structure, which were obtained from saturated solutions of H_2O and D_2O by slow evaporation of the solution, were irradiated with x-radiation with a dose of some 3 Mrad. The ESR spectra were taken in 2nd derivatives (flexion) at distances of 5°, the crystals turning around the three axes perpendicular to one another. The mechanism of the radiation-induced radical positions are discussed. (HK/LH) (GE)

7585 FREE RADICALS IN IRRADIATED DEUTERATED POLYETHYLENE AND POLYPROPYLENE. Klinshpont, E. R.; Milinchuk, V. K.; Pshezhgtskii, S. Ya. (Scientific-Research Inst. of the Rubber Industry, Moscow). Vysokomol. Soedin., Ser. A; 15: No. 9, 1963-1966(Sep 1973). (In Russian).

A 77°K, the G(R) values in deuteropolyethylene and deuteropolypropylene were half those in the non-deuterated polymers. In deuterated polyethylene gamma-irradiated at 77°K, the alkyl radicals ~ CD_2-CD-CD_2 ~ were formed, and in the temperature interval 77-300°K no effect of isotopic composition on radical recombination was observed. In deuterated polymers exposed to ultraviolet light, allyl radicals were converted to alkyl. In deuteropolypropylene exposed to ultraviolet light, peroxide radicals were converted to alkyl, with a 3-fold increase in the total radical concentration. (tr-auth)

7586 CHANGES IN BUTADIENE-NITRILE AND FLUORO RUBBER STRUCTURE BY GAMMA IRRADIATION. Makhlis, F. A.; Gubanova, G. G.; Popova, V. M. (Scientific-Research Inst. of the Rubber Industry, Moscow). Vysokomol. Soedin., Ser. A; 15: No. 9, 1995-2002(Sep 1973). (In Russian).

The effect of irradiation temperature and absorbed dose on cross-linking and destruction of butadiene-nitrile (BDN) and fluoro rubbers and their vulcanizates in the nondeformed and strained state was studied. Irradiation of BDN and its vulcanizates with low absorbed doses caused a simultaneous rupture of the mesh junctions and main chains of the polymer, and with high doses, destruction of the mesh junctions. Irradiation of fluoro rubbers (copolymers of vinylidene fluoride with hexafluoropropylene) caused rupture of the main chains with formation primarily of trifunctional mesh junctions. The rate of destruction of stressed vulcanizates was an order of magnitude or more greater than in nondeformed samples. (tr-auth)

7587 X-RAY INACTIVATION STUDIES OF NONHEME IRON PROTEINS: THE ACTION OF X RAYS ON SPINACH FERREDOXIN IN AQUEOUS SOLUTIONS. Krasnobajew, V. (Univ., Zurich). Biophysik; 10: No. 3, 213-220(1973).

Exposure of aqueous spinach ferredoxin solutions to x rays results in a rapid and irreversible denaturation of the molecule. The denaturation is manifested by a decrease of the characteristic absorption of spinach ferredoxin at 320 and 416 nm, and by the concomitant liberation of ferric iron and hydrogen sulfide. The absorption decrease at 320 and 416 nm and the iron liberation are found to parallel the activity decrease in functioning as electron transfer factor in the noncyclic electron transport system in spinach chloroplasts. X-ray inactivated spinach ferredoxin does not contain iron or free SH-groups, and can be regarded as an apo-form of the native protein. This x-ray-inactivated apoprotein, however, showed a higher molar extinction coefficient at 275 nm than the apoferredoxin, and was not reconstitutable. Spinach ferredoxin was found to be even more radiosensitive than clostridial ferredoxin. A G-value of 1.25 for biological inactivation and iron liberation was found, as compared to a G-value of 0.8 for clostridial ferredoxin. (auth)

7588 EFFECTS OF γ RAYS ON POLY-L-GLUTAMIC ACID IN AQUEOUS SOLUTION. Knikane, M.; Sugai, S. (Hokkaido Univ., Sapporo). Biophysik; 10: No. 3, 221-228(1973).

Salt-free and 0.2 M NaCl oxygenated aqueous solutions of poly-L-glutamic acid were irradiated with ^{60}Co-γ-radiation at various pH's to examine whether or not the changes caused by the exposure to ionizing radiation depend on pH, that is, the conformations of polypeptide. The G-values (the number of main-chain scissions per 100 eV of energy absorbed) in both salt-free and 0.2 M NaCl solutions of poly-L-glutamic acid were found to change sharply

with pH and to have a maximum value at the pH of a mid-point of helix-coil transition. The change of G-values with pH was discussed in terms of the conformational change of poly-L-glutamic acid. (auth)

7589 INFLUENCE OF ^{60}Co RADIATION ON HETEROGENEOUS CATALYSIS, DEMONSTRATED BY THE EXAMPLE OF REFORMING N-HEPTANE AT THE PLATINUM–ALUMINUM OXIDE CATALYST. Khursheed-ul-Islam. Clausthal, Ger.; Technische Univ. (1972). 107p. (In German).

Thesis.

The course of the heterogeneous catalytic process of the reforming of n-heptane at the platinum-aluminium oxide catalyst was investigated under radiochemical influence. The apparatus used permitted the catalytic system to be simultaneously irradiated or the catalyst samples even prior to the start of the reaction to be exposed to radiation under vacuum (10^{-2} to 10^{-3} Torr). A blank test (without catalyst) with only n-heptane run, showed that only a very small part (1.5 to 2.0 wt %) of the n-heptane was converted into fission products due to the γ-irradiation. The greatest radiation effects were shown by the tests in which the catalyst samples had been pre-irradiated for a long time under vacuum (10^{-2} to 10^{-3} Torr) prior to the start of the reaction. The yields of fission products and benzene as well as the total conversion increased compared to the basic test without irradiation, whereas the isoheptane and C_7-cyclopentanes greatly decreased. The toluene yield remained more or less the same. By doping tests with water it was found that the increased yield of fission products and benzene as well as the total conversion of irradiated catalyst samples is reduced by the addition of water and return to the value of the basic test. It was confirmed by infrared spectroscopical measurements that there actually is a desorption of water under irradiation. (GE)

7590 RADIATION GRAFTING OF VINYL MONOMERS TO LIGNIN. Pormale, M. Ya.; Kashkina, N. A.; Surna, Ya. A. (Inst. of Chemistry of Lignin, Riga). Khim. Drev.; No. 5, 103-107(1970). (In Russian).

The dependence of the degree of grafting of polystyrene to lignin on the radiation dose and intensity and the addition of water, sensitizers, and initiators of radical polymerization was investigated. It was shown that the degree of grafting depends on the dose and intensity of the radiation. An increase of the radiation dose from 5 to 25 Mrad at intensities of 70 rad/sec increases the degree of grafting of the polystyrene to the air-dried birch lignin 4 times. It was found that the addition of sensitizers and initiators of radical polymerization in the reacting system affects the degree of grafting negatively. The addition of 10% of carbon tetrachloride decreases the degree of grafting of the polystyrene by 50%. The dependence of the decrease of the water absorption and increase of the dimensional stability of the lignin on the degree of grafting of the polystyrene was studied. (tr-auth)

7591 RADIOLYSIS PRODUCTS OF INULIN IRRADIATED IN THE SOLID STATE. Bachman, S.; Zegota, H.; Antosik, B. (Miedzyresortowy Instytut Techniki Radiacyjnej Politechniki, Lodz, Poland). Nukleonika; 18: No. 6, 239-246(1973). (In Polish).

Radiolysis products of inulin: deoxysugars, hydrogen peroxide, formaldehyde and oxalic acid have been investigated. The concentration of free radicals and their stability in the samples stored several months after irradiation was estimated. The influence of oxygen on the radiolytic process in inulin irradiated in solid state was studied. (auth)

7592 PROTON PULSE RADIOLYSIS. Christensen, H. C. (AB Atomenergi, Studsvik, Sweden); Nilsson, G.; Thuomas, K. A.; Reitberger, T. Chem. Phys. Lett.; 22: No. 3, 533-536(15 Oct 1973).

A 5 MeV proton accelerator was used for pulse radiolysis of organic gases. The transient spectra obtained from the alkanes methane, ethane, propane, n-butane, and neopentane was tentatively assigned to alkyl radicals. Some methodological aspects of this new technique are discussed. (auth)

7593 DETECTION OF ELECTRONS IN PULSE IRRADIATED LIQUID HYDROCARBONS BY MICROWAVE ABSORPTION. Warman, J. M.; De Haas, M. P.; Hummel, A. (Interuniversitair Reactor Instituut, Delft, Netherlands). Chem. Phys. Lett.; 22: No. 3, 480-483(15 Oct 1973).

An apparatus for studying the absorption of microwave energy by electrons in pulse irradiated liquid hydrocarbons on a nanosecond time scale is described. The use of the technique is illustrated by results obtained in liquid iso-octane. Rate constants for the reaction of electrons with biphenyl and TMPD in iso-octane have been determined to be $(1.5 \pm 0.3) \times 10^{13}$ M^{-1} sec^{-1} and $(5 \pm 2) \times 10^{10}$ M^{-1} sec^{-1}, respectively. (auth)

7594 ELECTRON SPIN RESONANCE STUDY OF RECOMBINATION OF RADICALS TRAPPED IN SOME POLYMORPHOUS ORGANIC SOLIDS IRRADIATED AT 77°K. Mauer, D.; Tilquin, B.; Claes, P. (Univ., Louvain, Belg.). Bull. Soc. Chim. Belg.; 82: No. 9-10, 693-698(1973). (In French).

The recombination temperature (T_R) of radicals trapped in γ-irradiated organic solids showing phase transitions was determined. A comparison is made between T_R and the entropy of transition. It was concluded that radical diffusion is due to molecular reorganization during phase transition. (auth)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 9003.

Hot-Atom Chemistry

Refer also to abstract 7583.

7595 HOT HOMOLYTIC ALIPHATIC AND AROMATIC SUBSTITUTION S^{*}_{H2}. Machulla, H. J.; Stoecklin, G. (Kernforschungsanlage, Juelich, Ger.). (1973). vp.

From 7th international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

The pressure dependence of the stereochemical course in hot homolytic T-for-H and ^{38}Cl-for-Cl substitution in meso and racemic 1,2-dichloro-1,2-difluoroethane has been studied from about 10 to 10^4 torr. For both recoil tritium and chlorine, substitution with inversion of configuration is almost negligible in the gas phase and its yields remain constant over the entire pressure range studied. Typical pressure effects are observed, however, for substitution with retention of configuration, somewhat depending on the system. While the change from the high pressure gas phase to the liquid leaves T-for-H substitution almost unaffected, ^{38}Cl-for-Cl substitution exhibits strong phase effect. Pressure, phase (density) and moderator dependence of ^{38}Cl-for-F and ^{38}Cl-for-H substitution has also been studied in fluorobenzene. The density dependence in aromatic systems is completely different from in aliphatic systems, i.e., the drastic yield-increase accompanying the high pressure gas to liquid phase change is not observed. The isomer distribution is independent of the moderator concentration and is not affected by pressure and only very little by phase changes. Together with the previously reported conformational effect, the results provide information on the problem of direct reaction versus complex formation. While in aliphatic systems complex formation in S^{*}_{H2} if at all, seems to occur in the liquid phase only, hot homolytic aromatic substitution proceeds via $\pi\sigma$-complex formation already in the gas phase. (GE)

7596 CHEMICAL SENSITIVITY IN ORGANOMETALLIC HOT-ATOM REACTIONS. Wiles, D. R. (Carleton Univ., Ottawa). (1973). vp.

From 7th international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

Selectivity in condensed-phase hot atom reactions may arise both from selective bond breaking and from selective reaction of the hot atom or fragment with ligands available in the medium. Results of nuclear recoil studies of ^{56}Mn in $[CrFe(CO)_5]_2$ indicate very low yields of organomanganese compounds and suggest that chemical selectivity in this target must arise from selective bond breaking. In other cases, selective bond breaking is demonstrated not to be involved, and it can be shown that the observed products are derived from components in the medium rather than from the target compound. In favorable cases, where medium influences are minimal, the pattern of products of hot atom reactions may be used to identify the target compound. This now gives rise to the possibility of species-specific activation analysis, by which not only the element can be identified and measured, but also its chemical form. This will be illustrated for the case of environmental mercury analysis. (GE)

7597 HOT-ATOM CHEMISTRY OF SOLUTION-SOLID MIXTURES AND FROZEN SOLUTIONS OF TRIS(ACETYLACETONATO)COBALT(III). Tominaga, T. (Tokyo Univ.). Radioisotopes (Tokyo); 22: No. 8, 411-414(Aug 1973).

Mixtures in saturated benzene (or acetic acid) solution and solid $Co(acac)_3$ were irradiated with thermal neutrons and the ^{60}Co retention in the mixtures was determined. The ^{60}Co retention in the $Co(acac)_3$–acetic acid systems agreed with the theoretical value estimated by using the ^{60}Co retention in the solution and solid phase. The ^{60}Co retention in the frozen acetic acid solutions of

$Co(acac)_3$ at various concentrations was also investigated as similar heterogeneous systems. (auth)

7598 HOT-ATOM CHEMISTRY OF METAL COMPLEXES IN ORGANIC SOLVENTS. Tominaga, T. (Tokyo Univ.). Radioisotopes (Tokyo); 22: No. 2, 87-94(Feb 1973). (In Japanese).

Investigations and recent research developments concerning the scavenger effect of metal complexes in organic solvents are described. Retentions of ^{60}Co and ^{51}Cr were obtained after irradiating benzene solutions of 0.2–0.5 M $Co(acac)_3$ and $Cr(acac)_3$ with thermal neutrons in a nuclear reactor and separating the recoil products by the solvent extraction method and other methods. The retention values were greater than those of irradiated solid samples of the same complex. When metallic salts, such as Fe(III) and Al, with a molarity about $1/_{100}$ of the complex solution, were added to the complex solution, the retention became nearly 0% and did not increase even after many hours. The scavenger effect shown by such metallic salts was also observed in the solution of irradiated solid samples dissolved in the organic solvents. The retention values of the irradiated benzene solution of a nitrosonaphthorate complex varied according to the complex even though the solution contained a scavenger fully. It was considered that this was attributed to the cage reaction in addition to the primary retention. The scavenger effect during the thermal reaction of the solution depended on the kind of metallic salt added. The mechanism of the scavenger effect; for example in the $Co(acac)_3$ system, was proposed as follows: (1) recombination reaction, $[^{60}Co(acac)_{3-x}] + acac^- \rightarrow {}^{60}Co(acac)_3$, (2) scavenge reaction (complex formation reaction) $MXn + acac^- \rightarrow M(acac)n$, and (3) transfer reaction of ligand $[^{60}Co(acac)_{3-x}] + M(acac)n \rightarrow {}^{60}Co(acac)_3 + M(acac)m$ (n > m). In this case, $[^{60}Co(acac)_{3-x}]$ was assumed to be a ligand-deficient ^{60}Co recoil chemical species, and x as 1, 2, or 3 with positive charge. Additions, which produced a scavenger effect by other mechanisms, for example ammonium acetate and acetic acid, were also examined. (JA)

7599 SOLID-STATE ISOTOPIC EXCHANGE MODEL FOR ANNEALING REACTIONS OF RECOILED SPECIES STUDIED ON SOME CO(III) DOUBLE COMPLEXES. Lazzarini, E.; Fantola Lazzarini, A. L. (Politecnico, Milan). (1973). vp.

From seventh international hot atom chemistry symposium; Juelich, Germany (10 Sep 1973).

As has been shown in previous studies the annealing probability ratio in cationic and anionic sites of ^{60}Co double complexes is determinated mainly by the lattice structure, which is different for hydrated and dehydrated forms of the double complex. In continuation of these experiments the following complexes were studied: (1) the cis-$[Cr\ en_2\ Cl_2]\ [Co\ glyc_2\ (NO_2)_2] \times n\ H_2O$ complex in order to ascertain whether the ^{60}Co atoms recoiled from anionic sites can also anneal in cationic sites, and whether the two isochronal annealing curves of ^{60}Co atoms are correlated; (2) the trans-$[Co\ en_2\ (NO_2)_2]\ [Co\ EDTA] \times H_2O$ complex in order to compare the annealing probability ratio in cationic and anionic sites of the trans form with that observed previously for the cis form of the same double complex; (3) the cis-$[Co\ en_2\ (NO_2)\ CNS]\ [Co\ EDTA] \times 2\ H_2O$ complex in order to ascertain the reproducibility of the annealing probability ratio in materials coming from different preparation and irradiations. Furthermore it was investigated whether the annealing probability ratio can be influenced (a) by the kind of atmosphere in which the annealing is carried out and (b) by the γ dose (approximately 40 Mrad) delivered to the crystal sample after the neutron irradiation. (GE)

7600 STUDIES ON THE PREPARATION OF ORGANIC HALOGEN COMPOUNDS LABELLED BY ^{38}Cl. II. A Thin Layer Chromatographical Separation of the Main Component of the Organic Phase in Szilard–Chalmers Reactions of Aromatic Chloro Derivatives. Kim, Y. S. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 3, 202-213(Sep 1973).

Separation of the components in organic phases obtained from Szilard–Chalmers reactions of aromatic chloro derivatives was attempted to clarify the conditions of isolating the main component. Though all constituents could not be isolated, the main component was well isolated by means of a simple distillation or a thin-layer chromatography. The main component was a recombined product of the recoiled ^{38}Cl atom with the original sample. In cases of solid samples the main component amounted to about 80 to 60% of the radioactivity of the organic phase, whereas the main component from liquid samples gave less than 70% of the radioactivity of the organic phase. A prolonged irradiation could increase the yield of a main component, but, in the case of a radiation-sensitive compound, it was decreased as the irradiation is extended. The number of side products separated from an organic phase of a liquid sample was greater than that of a solid sample, and hence the main component of a solid sample was isolated easier. The overall yields of the labelled main products of 22 kinds of compounds were listed and a procedure of the separation of the main component by a thin layer chromatography was proposed and evaluated. The feasibility of the present procedure for labelling purposes was also reviewed with respect to the chemical structure of a compound. (auth)

7601 HOT-ATOM INITIATED CHEMICAL LASER STUDY OF THE $H^* + SF_6$ REACTION. Berry, M. J. (Univ. of Wisconsin, Madison). Chem. Phys. Lett.; 22: No. 3, 507-510(15 Oct 1973).

Chemical laser methods were used to study the "hot-atom" reaction: $H^* + SF_6 \rightarrow$ products at $KE_{rel} \leq 102$ kcal mole^{-1}. Collision-induced dissociation of SF_6 by H^* is the dominant reaction channel. Internal excitation of SF_6 may be required to promote the abstraction reaction: $H + SF_6 \rightarrow HF + SF_5$. (auth)

Properties of Radioactive Materials

Refer also to abstracts 7513, 7533, 7535, 7548, 7855, 7894, 8104, and 9044.

7602 (AED-C-13-9) BIBLIOGRAPHIES IN NUCLEAR SCIENCE AND TECHNOLOGY. Section 13: Decontamination. Philipp, H.; Wichmann, E. (comps.). (Zentralstelle fuer Atomkernenergie-Dokumentation, Leopoldshafen (F. R. Germany)). Sep 1973. 39p. (In Several Languages). Dep. NTIS (U. S. Sales Only) $4.00.

This bibliography contains 236 references on decontamination of buildings, grounds, materials, persons, animals, liquids, and gases. It covers the period October 1971 through June 1973. The material was taken from Nuclear Science Abstracts and Chemical Abstracts. (LK)

7603 POLAROGRAPHIC BEHAVIOR OF UO_2^{++} IN THE PRESENCE OF PYRIDINE AND HYDRAZINE. Almagro, V.; Garcia, F. S.; Sancho, J. (Universidad Autonoma, Madrid). (1973). vp.

From 24th IUPAC congress; Hamburg, Germany (2 Sep 1973).

The polarographic study of UO_2^{++} ions in the presence of pyridine and hydrazine shows a strict linearity between wave height and concentration in both cases, with a pH of solutions that has to be lower than 3.5. The electrode processes are almost reversible. In the case of pyridine, a velocity constant $K_0 = 0.187 \times 10^{-3}$ has been found and a transfer coefficient $\alpha = 0.78$, the respective values for hydrazine being $K_0 = 1.079 \times 0^{-3}$ and $\alpha = 0.80$. In both cases the results lead to the conclusion that the complexes formed have the same structure $B_2 \times UO_2^{++}$; the oxidized forms, however, have a higher stability as compared to the reduced forms. (RB) (GE)

7604 USE OF A TIME SHARING COMPUTER PROGRAM FOR CALCULATING AND PLOTTING RADIOCHROMATOGRAPHIC DATA. Nuclear Medicine Technical Note. DHEW Publication No. (FDA) 72-8018. Cincinnati; Bureau of Radiological Health (Feb 1972). 4p.

A technique for radiochromatographic determination of the radiochemical purity of labeled human serum albumin (^{99m}Tc HSA) is described and the execution of the program called CHROM2 for calculation and plotting of the data is explained. The technique can be applied to other radiopharmaceuticals and to other techniques such as Gel Filtration chromatography. (auth)

7605 KIT FOR TECHNETIUM-99m MACROAGGREGATED ALBUMIN. Nuclear Medicine Technical Note. DHEW Publication No. (FDA) 72-8010. Cincinnati; Bureau of Radiological Health (Aug 1971). 2p.

Technetium 99m MAA is a desirable agent for lung scanning because ^{99m}Tc emits a high yield of 140 keV gamma rays which are ideal for high resolution imaging and because of the biological properties of macroaggregated albumin, i.e., short biological half-life of 90 to 120 minutes (determined by whole body counting normal volunteers) and ease with which the tagged biological is metabolized and excreted. The overall effect of these desirable qualities of ^{99m}Tc MAA is dose reduction to the patient, while increasing the activity to the millicurie range. A fairly simple "kit" for routine preparation of ^{99m}Tc MAA is described. (auth)

7606 HYDROGEN BOND IN THE AMMONIUM OXYFLUORIDE COMPOUNDS OF MOLYBDENUM, TUNGSTEN, AND URANIUM. Opalovskii, A. A.; Kuznetsova, Z. M. (Inst. of Inorganic Chemistry, Novosibirsk, USSR). Izv. Sib. Otd. Akad. Nauk SSSR, Ser. Khim. Nauk; No. 5, 62-68(Sep 1973). (In Russian).

Analysis of the crystal-optic, ir, and NMR spectroscopic data for previously obtained ammoniumoxyfluoride compounds of molybdenum, tungsten, and uranium is given. Hydrogen bonds have been shown in these compounds. (auth)

7607 LANTHANIDES, INCLUDING SCANDIUM AND YTTRIUM AND THE ACTINIDES. Part 3. The Actinides. McClev-

erty, J. A. (Univ. of Sheffield, Eng.). pp 462-472 of Inorganic Chemistry of the Transition Elements. Vol. 2. Johnson, B. F. G. (ed.). London; Chemical Society (1973).

A review is presented of recent publications on the inorganic chemistry of the actinides. The section headings are: the general chemistry of actinide elements and uranyl and neptunyl compounds. (UK)

7608 EARLY TRANSITION METALS. Part 7. Technetium and Rhenium. Garner, C. D. (Univ. of Manchester, Eng.). pp 162-163 of Inorganic Chemistry of the Transition Elements. Vol. 2. Johnson, B. F. G. (ed.). London; Chemical Society (1973).

A review is presented of recent publications on the inorganic chemistry of technetium and rhenium. The sectional headings are: carbonyl complexes (halogeno-complexes, O- or S- donor ligands, Si-donor ligands); dinitrogen, isocyanide and nitrile complexes; hydrido-complexes; rhenium(II) complexes; rhenium(III) complexes; technetium(IV) and rhenium(IV) complexes; technetium(V) and rhenium(V) complexes; technetium(VI) and rhenium(VI) complexes; technetium(VII) and rhenium(VII) complexes. (UK)

7609 MAGNETOCHEMICAL AND SPECTROSCOPICAL STUDIES ON ORGANO-METALLIC ACTINOID COMPLEXES. Kanellakopulos, B.; Aderhold, C. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp. (In German).

From 24th UIPAC congress; Hamburg, Germany (2 Sep 1973).

Tri-cyclopentadienyl complexes of tervalent actinides as Lewis acids form with bases stable 1 : 1 adducts, which can be isolated, of the composition $(C_5H_5)_3An \times B$. The uranium(III) to americium(III) ions and base cyclohexylisonitrile ($C_6H_{11}CN$) compounds were synthesized and spectroscopically as well as magnetochemically investigated. The interpretation of their physical properties gives the electron structure of the actinide ions under the influence of the potential of the crystalline surroundings and enables the estimation of the direct electronic interaction between the central ion and the ligand system. A clear deviation of the experimentally determined dissociation factor from the pure ionic Lande-factor resulted from the magnetic properties of this complex series. Various bond models such as direct overlapping of 5f and ligand orbitals and charge transfer by configuration interaction are discussed, and the measuring data are compared with those of the iso-electronic lanthanide compounds. (GE)

7610 STRUCTURE OF ANHYDROUS URANYL CHLORIDE BY POWDER NEUTRON DIFFRACTION. Taylor, J. C.; Wilson, P. W. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Acta Crystallogr., Sect. B; 29: No. 5, 1073-1076(15 May 1973).

Other workers have previously studied the structure of anhydrous UO_2Cl_2 by X-ray powder diffraction methods. In this earlier work, the oxygen atom locations could not be determined because of the heavy scattering by the uranium atom, and these were deduced from geometrical considerations. The present powder diffraction analysis, with the profile fitting technique, has revealed errors of 0.56 and 0.17 Å in the earlier proposed oxygen positions, and 0.16 Å in the chlorine location. The interatomic distances and angles from the neutron diffraction analysis are normal. (auth)

7611 CONTRIBUTION TO THE STUDY OF THE MECHANISM OF LABELLING HUMAN SERUM ALBUMIN (HSA) WITH TECHNETIUM-99m. Zolle, I.; Oniciu, L.; Hoefer, R. (Univ., Vienna). Int. J. Appl. Radiat. Isotop.; 24: No. 11, 621-626(Nov 1973).

The labelling reaction using ferric chloride and ascorbic acid with the ^{99m}Tc eluate was investigated. Ion exchange chromatography was used to separate the reaction components at acidic and alkaline pH. ^{99m}Tc was identified as an anion which was not complexed with ascorbic acid. Coprecipitation was used to differentiate between pertechnetate and a reduced form of technetium. Only the reduced technetium showed coprecipitation with ferrous/ferric hydroxide. Coprecipitation was favored at elevated pH, suggesting that a hydrated ^{99m}Tc oxide was formed. It is believed that this labels the albumin. (auth)

7612 DIFFUSION COEFFICIENTS OF URANYL IONS IN MELTS OF ALKALI METAL HALIDES AND THEIR MIXTURES. Smirnov, M. V.; Borodina, N. P.; Komarov, V. E. Tr. Inst. Elektrokhim., Ural. Nauch. Tsentr. Akad. Nauk SSSR; 18: 64-68 (1972). (In Russian).

Diffusion coefficients were measured for uranyl ions in the following melts—3 LiCl–2KCl; NaCl–KCl; KCl; RbCl; and CsCl–in the temperature interval 441 to 921°C. It was established that the diffusion coefficient of UO_2^{++} decreased in the order above and increased with temperature. (auth)

7613 DIFFERENTIATING HOMOGENEOUS BEDS FROM HETEROGENEOUS ONES WITH EQUAL AVERAGE HYDROGEN CONTENT. Zendrikov, G. M. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 86-92 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

On the basis of the calculated data the possibility of the differentiation of interbedded regions of strata by the readings of standard neutron methods and the effect of the lamination of the strata during determination of its average hydrogen content by radioactive logging methods were studied. Alternating sandy-clay strata, crossed by wells with a diameter of 250 mm, were examined. (tr-auth)

7614 PRODUCTION OF INORGANIC COMPOUNDS LABELED WITH RADIOACTIVE ISOTOPES. Laszlo, S.; Maria, D.; Tamas, L.; Janos, M.; Laszlo, R.; Geza, T.; Janos, T.; Laszlo, Z. pp 11-20 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

Results achieved in the production of new compounds and in the improvement of their quality are summarized. The processing of ^{111}Ag and ^{125}I formed by (n,γ) nuclear reactions and the chelate-extraction separation of certain high-purity isotopes produced in (n,p) reactions are described as examples. Some work on improving safety conditions is also reported. (auth)

7615 CHROMATOGRAPHICAL DETERMINATION OF RADIOCHEMICAL PURITY OF HIPPURAN-^{131}I. Kim, J.; Kim, T. H. (Atomic Energy Research Inst., Seoul). J. Korean Nucl. Soc.; 5: No. 3, 234-239(Sep 1973).

A recently known method of paper chromatographical separation of o-iodobenzoic acid-^{131}I and o-iodohippuric acid-^{131}I was found to be in error. The solvent mixture proposed in the method for the efficient separation of the two compounds of similar structure is not only made nonhomogeneous but also brings about no separation. It was also confirmed that no o-iodohippuric acid is converted to o-iodobenzoic acid during the process for Hippuran-^{131}I preparation by isotopic exchange. An alternate method of chromatographical determination of radiochemical purity of Hippuran-^{131}I is proposed. (auth)

7616 LUMINESCENCE SPECTRA AND DECAY TIMES OF PER-DEUTERATED URANYL ACETATES. Tripathi, H. B.; Joshi, G. C.; Pant, D. D. (Government Coll., Naini Tal, India). Indian J. Pure Appl. Phys.; 11: No. 5, 377-378(May 1973).

Fluorescence spectra and decay times of $UO_2(CH_3COO)_2 \cdot 2H_2O$, $UO_2(CH_3COO)_2 \cdot 2D_2O$, $UO_2(CD_3COO)_2 \cdot 2H_2O$, and $UO_2(CD_3COO)_2 \cdot 2D_2O$ are studied. The spectra of all these four compounds are similar except a violet shift ($\approx$4 cm^{-1}) in the main series of bands for the deuterated compounds and also some differential changes in the ligand bands when the CH_3 group is replaced by the CD_3. The substitution of deuterium in place of hydrogen in the CH_3 group produces a very small change in the decay times. But the replacement of H_2O by D_2O produces a pronounced effect on the decay time. A careful study of the lifetime data shows that the high frequency O–H vibrations is more susceptible to radiationless transitions than the CH_3 group vibrations. (auth)

7617 SYNTHESIS AND CHARACTERIZATION OF DIETHYLMETHYLENE DIPHOSPHONATO METAL COMPLEXES. Mikulski, C. M.; Karyannis, N. M.; Pytlewski, L. L.; Hutchins, R. O.; Maryanoff, B. E. (Drexel Univ., Philadelphia). J. Inorg. Nucl. Chem.; 35: No. 12, 4011-4021(Dec 1973).

Reactions of tetraethylmethylene diphosphonate (TEMDP) with metal chlorides at elevated temperatures lead to the formation of complexes of the types M(L)(LH)(M = Al, Ti, V, Cr, Fe, Dy); M(L)(LH)$_2$(M = Th, U) and M_2(L)(LH)$_2$(M = Co, Ni), where L is the diethylmethylene diphosphonato (DEMDP) ligand. The new complexes are insoluble in all common organic solvents and do not melt or decompose at temperatures up to 300 to 350°C; furthermore, the Ti(III), V(III), Cr(III), Fe(III) and U(IV) complexes exhibit subnormal magnetic moments. These properties are strongly in favor of polynuclear structures. Spectral and magnetic studies suggest that the M(III) complexes are distorted octahedral, the M(II) compounds pentacoordinated, with a low symmetry square pyramidal configuration, and the M(IV) complexes octa- or ennea-coordinated. DEMDP acts as a tridentate bridging ligand, involving an uncoordinated P = O group, whereas its monoprotonated derivative also acts as tridentate in the M(III) complexes; in the M(II) and M(IV) complexes one LH ligand acts as tridentate, while the other is, most probably, bidentate. Possible structures for the new complexes and the nature of the synthetic reactions are discussed. (auth)

7618 SOLVATION EQUILIBRIA IN METHANOL AND ACETONITRILE OF THE QUINOLINE N-OXIDE COMPLEXES OF SOME HIGHER VALENT METAL OXOCATIONS. Majumdar, A. K.; Bhattacharyya, R. G. (Jadavpur Univ., Calcutta). J. Inorg. Nucl. Chem.; 35: No. 12, 4296-4300(Dec 1973).

Quinoline N-oxide complexes, such as $UO_2Cl_2 2QO$, $UO_2Br_2 2QO$, $UO_2(NO_3)_2 2QO$, $UO_2(NCS)_2 2QO$, $VOCl_2 2QO$ and $Zr_2OCl_2 2QO$ undergo extensive solvation reaction in methanol. A study has been made of the molar conductances of the solutions of the complexes of different concentrations in methanol. Measurements have been made also of the molar conductances of $UO_2(NCS)_2 3QO$ and $VOCl_2 2QO$ at different concentrations in acetonitrile. The results are presented and conclusions are drawn. (UK)

7619 ELECTRON EXCHANGE REACTION BETWEEN U(VI) AND Sn(II) IN VARIOUS HYDROCHLORIC ACID AQUEOUS SOLUTIONS. Mayhew, R. T.; Amis, E. S. (Univ. of Arkansas, Fayetteville). J. Inorg. Nucl. Chem.; 35: No. 12, 4245-4253(Dec 1973).

The electron exchange reaction between U(VI) and Sn(II) was studied in various concentrations of hydrochloric acid ranging from 1.0 to 6.0 molar in water solutions. The reaction was second order overall at all HCl concentrations. The rate of the reaction and the Arrhenius parameters were found to be periodic functions of the hydrogen ion concentration. Salt effect studies showed catalysis of the reaction by iron(III) and copper(II). The catalyses indicate one electron step reductions of the U(VI). (auth)

7620 KINETICS OF EXCHANGE BETWEEN AMERICIUM(III) AND EUROPIUM ETHYLENEDIAMINETETRAACETATE. Choppin, G. R.; Williams, K. R. (Florida State Univ., Tallahassee). J. Inorg. Nucl. Chem.; 35: No. 12, 4255-4269(Dec 1973).

The kinetics of exchange has been studied for Am^{3+} and $EuEDTA^-$ in an aqueous solution of 0.1 M total ionic strength with acetate buffer. The kinetic equation involved both acid dependent and acid independent terms. Possible mechanisms consistent with the complete rate equations of the two (acid dependent and acid independent) paths are proposed. The two paths have approximately equal probability at pH 6.4. An increase in the acetate buffer concentration increases the rate of the acid dependent pathway but decreases that of the acid independent one. The effects of buffer concentration can be explained in terms of complexation by acetate of either the free metal ions or the metal-EDTA complex. (auth)

7621 MECHANISMS OF IN-PILE FISSION GAS RELEASE FROM UO_2. Shiba, K.; Handa, M.; Yamagishi, S.; Fukuda, T.; Takahashi, Y.; Tanifuji, T.; Omori, S.; Kondo, A. (Japan Atomic Energy Inst., Tokai). J. Nucl. Mater.; 48: No. 3, 253-263(Oct 1973).

In-pile release mechanisms of fission gas from UO_2 at low temperatures were studied. The release of ^{133}Xe, ^{135}Xe, ^{138}Se, ^{85m}Kr, ^{85}Kr, and ^{87}Kr from a sintered UO_2 pellet was measured at temperatures ranging from 250 to 930°C using a graphite specimen holder. The release from the holder, in which a fraction of fission gas recoil-implanted, was subtracted to obtain the net release from the UO_2 pellet. Knock-out release from the UO_2 was measured directly, and it was found that it was not the main release mechanism, at least not for short-lived nuclides. A "pseudo-recoil" release model is proposed to explain the low temperature release under irradiation. In the model, some of the defects produced by fission fragments act as short-lived carriers for fission gas. (6 figures, 23 references) (auth)

7622 CONTRIBUTION TO THE STUDY OF THE HYDROXYLATED FORMS OF THE PLUTONYL ION. Musante, Y. (CEN, Cadarache, France); Porthault, M. Radiochem. Radioanal. Lett.; 15: No. 4-5, 299-306(20 Nov 1973). (In French).

Plutonyl perchlorate solutions are analyzed by absorption molecular spectroscopy at different pH and constant ionic strength. The variations of the characteristic band at about 830 nm display the formation of successive hydroxyled compounds. A qualitative and quantitative interpretation is suggested and compared to the works published in the literature about this subject. (auth)

Radioactive Waste Treatment

Refer also to abstracts 8389, 8392–8397, 8401, 8402, 8405–8407, 8414, 9297, and 9398.

7623 (CONF-721107-, pp 449-487) SURVEY OF THE PRESENT STATE OF STUDIES ON THE SOLIDIFICATION OF FISSION PRODUCT SOLUTIONS IN ITALY. Bocola, W.; Donato, A.; Sgalambro, G. (CNEN, Rome). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

A pot-vitrification process was developed in Italy for fixation of fission products both in phosphate or borosilicate glasses. The process was tested on a bench-scale plant with simulated fission product solutions. Red phosphorus was employed as a glass forming additive in order to strongly denitrate very clean wastes, while phosphoric acid was used in the treatment of dirty or sulphate-rich solutions. By means of red phosphorus, ruthenium loss from the vitrification pot was lowered to <1%. Laboratory studies were carried out to investigate both the efficiency of a ferric oxide-silica filter for gaseous RuO_4 removal under various conditions and the reaction of red phosphorus with fission product solutions. A bench-scale solidification plant, with special provision to remotely control operations in order to enable it to work in a hot cell, was constructed and tested with cold runs; in the near future it will be operating with fully radioactive wastes. (auth)

7624 (CONF-721107-, pp 489-514) PILOT PLANT EXPERIENCE ON HIGH-LEVEL WASTE SOLIDIFICATION AND DESIGN OF THE ENGINEERING PROTOTYPE VERA. Guber, W.; Diefenbacher, W.; Hild, W.; Krause, H.; Schneider, E.; Schubert, G. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

A general description of the solidification process developed at the Karlsruhe Nuclear Research Center is given together with a short review of the main inactive pilot plant experience gained. The basic features of the multipurpose engineering prototype solidification plant VERA 2 actually under design are presented. In this plant the high-level waste solutions from the first German reprocessing plant WAK shall be processed. (auth)

7625 (CONF-721107-, pp 515-553) STUDIES ON THE BEHAVIOR OF RADIOACTIVE WASTE GLASSES. Heimerl, W.; Heine, H.; Kahl, L.; Levi, H. W.; Lutze, W.; Malow, G.; Schiewer, E.; Schubert, P. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The program at HMI deals with physical and chemical aspects of boro-silicate waste glasses and contributes to engineering programs at GfK, Karlsruhe, and KFA, Juelich. The process of devitrification was investigated. Some crystalline phases were identified and are characterized in terms of fission product enrichment and leachability. Hot spot formation is considered. The relative importance of powder leaching and block leaching is discussed in view to the recent IAEA recommendation. Leaching kinetics is investigated and interpreted on the basis of well-known mechanisms. (auth)

7626 (CONF-721107-, pp 555-591) EXPERIENCE ACQUIRED IN FRANCE IN THE PROCESSING BY VITRIFICATION OF CONCENTRATED SOLUTIONS OF FISSION PRODUCTS. Bonniaud, R.; Laude, F.; Sombret, C. (CEA, Marcoule, France). Mar 1973. (In French).

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The techniques developed in France are described and the performances analyzed. Two processes assure the vitrification of fission product solutions: the one, batch vitrification taking advantage of a method in use at Marcoule in the industrial pilot plant PIVER; the other, continuous vitrification, is actually in development on an industrial scale. The evaluation of three years of experience in use at PIVER is given. The encasing in glass of calcined material is likewise envisaged for particular cases. The storage of glasses in deep artificial holes ventilated by air circulation is described and the observations on development are commented on. (tr-auth)

7627 (CONF-721107-, pp 593-612) GLASSES FOR THE FIXATION OF HIGH LEVEL RADIOACTIVE WASTES. Grover, J. R. (Atomic Energy Research Establishment, Harwell, Eng.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Glasses for the fixation of high level radioactive wastes must maintain their integrity in storage for centuries in spite of severe conditions of temperature and radiation. In addition they must be capable of easy formation in a fixation process such as FINGAL. Preliminary results were presented at the Richland Symposium in 1966 and this paper describes the entire program, in which an additional two years' work on both leaching and volatilization were carried out. Both phosphate and borosilicate glass compositions were used and the effect of radiation doses up to 10^{11} rad was determined for samples held at temperatures from room temperature up to 800°C. Detailed experiments were also carried out to study the effects of temperatures and rates of cooling on the stability of the glasses. Activity can be released from glasses by volatilization as well as leaching, so the effect of possible storage environments on the release of both fission products and the major glass-forming constituents were examined. The results confirm that a borosilicate glass is preferable to a phosphate glass for the fixation of high level wastes and certain limitations on storage conditions are indicated. (auth)

7628 (CONF-721107-, pp 615-654) HIGH-LEVEL WASTE SOLIDIFICATION DEMONSTRATION PROGRAM. Blasewitz, A. G. (Westinghouse Hanford Co., Richland, WA); Richardson, G. L.; McElroy, J. L.; Mendel, J. E.; Schneider, K. J. Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The High Level Waste Solidification Demonstration Program has involved pilot plant demonstrations with three alternative solidification systems: phosphate glass solidification, spray solidification, and pot calcination. The demonstrations have been performed with solutions having chemical compositions and radioactivity levels comparable to those which will exist in commercial fuel reprocessing plants. Extensive studies have also been conducted to determine the requirements for treating the effluents from the solidification processes and to evaluate the solidified waste products. The program data have been evaluated to provide a comparison of the processing parameters, product characteristics, industrial application potentialities, and economics associated with the solidification systems. (auth)

7629 (CONF-721107-, pp 655-681) LAB-SCALE R + D WORK ON FISSION PRODUCT SOLIDIFICATION BY VITRIFICATION AND THERMITE PROCESSES. Rudolph, G.; Saidl, J.; Drobnik, S.; Guber, W.; Hild, W.; Krause, H.; Mueller, W. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Several kinds of vitrified products with incorporated simulated high-level wastes were synthesized and their physical and chemical properties were studied, especially those important for processing and handling of the products and for secular storage. From the investigations a glass type has been selected for practical application in HLW solidification. A laboratory-scale plant was built and tested with inactive and high-level material. A thermite process for the solidification of high-level fission product solutions is under development as a potential alternative to vitrification. Model tests with inactive materials produced the best results with thermite mixtures containing calcined fission products, manganese dioxide, aluminum, and silicon dioxide. (auth)

7630 (CONF-721107-, pp 683-704) WASTE IMMOBILIZATION PLANT AT TARAPUR: A SURVEY OF PROCESS AND DESIGN FEATURES. Sunder Rajan, N. S.; Kumra, M. S.; Thomas, K. T. (Bhabha Atomic Research Centre, Trombay, India). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Major features of the plant for immobilization of the highly radioactive wastes generated at the fuel reprocessing plant at Tarapur, designed to reprocess spent fuels from the Tarapur and Rajasthan Atomic Power Stations, were surveyed. Nature of the wastes and glass matrices used for their solidification and their characteristics are discussed. Process details and design features of the facility, with particular reference to the process cells, are reviewed. Also included is a general description of the post-process facility for interim storage of solidified waste product canisters under continuous surveillance. (auth)

7631 (CONF-721107-, pp 705-729) INTERIM STORAGE AND SOLIDIFICATION FOR THOREX-TYPE FISSION PRODUCT SOLUTIONS. Halaszovich, S.; Laser, M.; Merz, E.; Rattay, K. H.; Storch, S.; Thiele, D. (Kernforschungsanlage, Juelich, Ger.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Highly radioactive fission product solutions resulting from reprocessing of thorium-containing fuel elements (THOREX-Process) are interim stored in a special tank equipment at KFA Juelich. Six cylindrical tanks (1-m^3 volume each) are installed in cells built of concrete blocks. The tanks have a conical bottom, a coolant jacket, and a lid in which all pipes are fixed. In the course of reprocessing spent HTGR-fuel, a rather serious problem is the solidification and final disposal of the highly radioactive fission product waste solutions. A survey is given on the choice of a suitable process. Description of the proposed flowsheet as well as long-term storage and safety considerations are included. In an appendix to this paper an alternative solidification process flowsheet developed by the German Gelsenberg company is presented in brief. (auth)

7632 (CONF-721107-, pp 731-761) SOLIDIFICATION OF HIGH-LEVEL RADIOACTIVE WASTES AT THE IDAHO CHEMICAL PROCESSING PLANT. Lakey, L. T.; Wheeler, B. R. (Allied Chemical Corp., Idaho Falls, ID). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Since 1963, high-level radioactive wastes at the U.S.A.E.C. Idaho Chemical Processing Plant have been solidified by the fluidized-bed calcination process. About 9×10^6 liters of liquid wastes from the reprocessing of aluminum- and zirconium-alloy fuels have been calcined to produce about 1,000 m^3 of granular solids. Decontamination factors of 10^7 on particulates and 10^6 on ^{106}Ru, which can volatilize at the calcination temperature, are being attained. The solids produced in the process are carried pneumatically to stainless-steel bins within underground concrete vaults. Though the granular product can be retrieved, the storage system is designed for a lifetime of over 500 years. Several improvements have been made which have increased plant capacity 50% above the design rate, and on-stream factors of 75 to 100% have been achieved in five operating campaigns. In addition, supporting work is directed at developing flowsheets for other wastes —e.g., high-salt wastes from second- and third-cycle extraction processing, neutralized Purex wastes, and contaminated organic wastes. (auth)

7633 (CONF-721107-, pp 763-788) STUDY OF BITUMINIZATION AS A METHOD OF TREATING HIGH-ACTIVITY WASTE. Zakharova, K. P.; Kulichenko, V. V.; Martynov, Yu. P.; Sobolev, I. A.; Khomchik, L. M. (State Committee on the Utilization of Atomic Energy, Moscow). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Two factors are considered, which might limit the use of bitumens for treating high-level wastes: radiation stability and the possibility of heat release. Investigation of the changes in chemical composition and in physico-chemical and structural-mechanical properties under irradiation showed that the composition of bitumen materials is changed as a result of radiation-induced oxidation and polymerization. The effect of the specific activity and composition of the wastes on these processes is determined. The paper includes results obtained in the experimental storage of bitumen blocks with a specific activity between 0.1 and 50 Ci/liter. The possibility of heat removal from stored bitumen blocks with a specific activity of up to 300 Ci/liter and ways of achieving it are demonstrated on the basis of thermo-physical studies. (auth)

7634 (CONF-721107-, pp 1045-1055) DEVELOPMENT OF TECHNIQUES FOR THE PRE-DISPOSAL TREATMENT OF WASTE ARISING IN NUCLEAR FUEL REPROCESSING BY THE HEXAFLUORIDE METHOD. Krylova, N. V.; Kulichenko, V. V.; Martynov, Yu. P. (State Committee on the Utilization of Atomic Energy, Moscow). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing, Paris, France (27 Nov 1972).

Burial of wastes resulting from the reprocessing of nuclear fuel by the method of volatile fluoride sublimation and subsequent fractional distillation or adsorption to free the uranium and plutonium from fission products is discussed. Two types of wastes are considered: (1) those containing fluoride fission products of low volatility and (2) those containing fluoride fission products of high volatility. The suitability of the two types of waste for burial is considered. It is suggested that wastes containing fluorides of low volatility can be converted into discrete blocks of the cryolite type. Various compositions are considered and the most suitable system for long-term burial is selected. The requirements for the burial, without special thermal treatment, of a second type of waste are discussed. The conditions for the burial of both types of waste are based on thermo-physical calculations. (auth)

7635 (CONF-721107-, pp 1081-1110) RECOVERY OF TRANSPLUTONIUM ELEMENTS FROM FUEL REPROCESSING HIGH-LEVEL WASTE SOLUTIONS. Koch, G.; Kolarik, Z.; Haug, H.; Hild, W.; Drobnik, S. (Kernforschungszentrum, Karlsruhe, Ger.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

A process for the recovery of americium and curium values from Purex-type high-level waste solutions is under development at Karlsruhe. The high-level waste is denitrated and the resulting fission product precipitate sent to HLW-solidification. The actinide/lanthanide fraction which has been kept in solution is separated by a HDEHP solvent extraction cycle. The lanthanides are sent to waste solidification, while the Am/Cm is further purified by cation exchange. Results of "cold" flowsheet tests are reported. (auth)

7636 (DP-1340) CONFINEMENT OF AIRBORNE RADIOACTIVITY. Progress Report: January–June 1973. Evans, A. G. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). Oct 1973. Contract AT(07-2)-1. 13p. Dep. NTIS $4.00.

Radiolytic desorption tests of a series of carbon samples containing KI_3, KI, triethylenediamine (TEDA), or combinations of TEDA and KI showed that a 10 × 16 mesh coconut shell carbon containing 1% TEDA, 2% KI, and a proprietary flame retardant retained iodine better than all products tested except those con-

taining higher TEDA concentrations. Ignition temperature measurements on the same series of samples showed that the 1% TEDA–2% KI product has an ignition temperature of about 330°C under SRP flow conditions (the same as the KI_3 carbon). The 1% TEDA–2% KI carbon has been selected to replace the unimpregnated carbon currently used in the Savannah River reactor confinement system. (auth)

7637 SOME PROBLEMS OF AIR CLEANSING BY THE SEPARATION OF RADIOACTIVE MOLECULAR IMPURITIES AND DISPERSED SOLID PARTICLES. Jozsef, H.; Oszkar, P.; Gyoergy, C. pp 95-113 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

Certain aspects of the disposal of gaseous wastes have been under investigation since 1966. Tasks dealt with during this period include the measurement of filtration efficiencies under laboratory and pilot-plant conditions; the mechanism of aerosol formation; the collection, classification and analysis of aerosols; and the construction of generators for the production of artificial aerosols. (auth)

7638 DISPOSAL OF RADIOACTIVE WASTES AT THE INSTITUTE OF ISOTOPES OF THE HUNGARIAN ACADEMY OF SCIENCES. Jozsef, H.; Oszkar, P. pp 289-307 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

Several evaporation methods and apparatuses (kettles, thin layer evaporators, infrared evaporators) were developed for reducing bulk wastes. Large volumes are cleared by using ion exchangers and chemical treatment. Concentrates remaining after processing are cased in concrete. (auth)

7639 USABILITY OF SOME ADSORBENTS FOR THE DECONTAMINATION OF RADIOACTIVE SEWAGE. Otto, R.; Hecht, P. (Zentralinstitut fuer Isotopen und Strahlenforschung, Leipzig). Isotopenpraxis; 9: No. 3, 101-104(Mar 1973). (In German).

The use of gas adsorbents, ash of brown coal, and powdery building materials for the decontamination of radioactive sewage was investigated. The model water containing several radionuclides is stirred with the adsorbent or filtered through a layer of it. The gas adsorbent is able to remove more than 90% of the radioactivity. An efficiency of up to 99% can be obtained for the decontamination of $^{90}Sr/^{90}Y$ by application of the other materials, depending on the addition of small amounts of Na_2CO_3, $NaHCO_3$, NaF, or NaOH. Detergents and complexing agents diminish the decontamination. (auth)

7640 RADIOACTIVE WASTE MATERIALS FROM AQUEOUS REPROCESSING OF SPENT NUCLEAR FUELS. Sachse, G.; Anders, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 2, 37-47(Feb 1973). (In German).

After giving a brief foundation of the necessity to reprocess spent nuclear fuels the principle of the Purex process as the main procedure used and the radioactive waste materials occurring in the individual stages of the process are described. In particular, high-level waste solutions are considered. Their amount and chemical composition are compiled in tables for different reprocessing techniques. Possibilities of treatment and the properties of solidified waste concentrates are discussed. Separation and concentration processes for gaseous radioactive waste are elucidated. Examples for the waste materials of different level of activity produced in different amounts are presented at the reprocessing plants of Karlsruhe (WAK) and Mol (Eurochemic). Costs of waste treatment and disposal are considered. (auth)

Radioisotope Production

Refer also to abstracts 8135 and 9319.

7641 (CEA-N-1635) USE OF TRILAURYLAMMONIUM NITRATE IN THE PROCESSING OF IRRADIATED NEPTUNIUM TARGETS. Golinski, M.; Koelhy, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Aug 1973. 17p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The possibility of separating ^{236}Pu from ^{237}Np by selective back extraction of plutonium from an organic solution of trilaurylammonium nitrate was investigated using a liquid-liquid countercurrent technique. Pelargonic acid was added to the plutonium- and neptunium-bearing organic solution in order to facilitate the plutonium back extraction: the distribution coefficients of the elements at the fourth oxidation state are thus clearly lowered and the plutonium back extraction into a nitrate solution of ferrous sulfamate is made possible. Plutonium yield and decontamination factors greater than 0.999 and 10^4 respectively have been found in liquid-liquid countercurrent scheme demonstration. (FR)

7642 (JINR-P12-7280) FAST GAS-THERMOCHROMATOGRAPHIC METHODS OF RADIOACTIVE ELEMENT SEPARATION. III. Production and Thermochromatographic Behavior of Ultramicroquantities of Volatile Oxides and Tungsten Hydrooxides. Bayar, B.; Votsilka, I.; Zaitseva, N. G.; Novgorodov, A. F. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

High-temperature (> 1000°C) sublimation and thermochromatographic behavior of ultra- and microquantities of tungsten in the oxygen stream were investigated in relation to the partial pressure of the water vapor in gas-carrier, the rate of gas-carrier, and the time of sublimation. Based on the data obtained, the fast gas-thermochromatographic method of separation of radiochemically pure, carrierfree tungsten from the Ta and Au targets irradiated with high-energy protons, has been developed.

7643 SEPARATION OF TIN-113 AND INDIUM-113m BY THIN-LAYER CHROMATOGRAPHY. Maki, Y. (Industrial Research Inst. of Kanagawa Prefecture, Yokohama). Jap. Anal.; 22: No. 7, 856-860(Jul 1973). (In Japanese).

The separation of ^{113m}In from a mixture of ^{113}Sn–^{113m}In in a radioactive equilibrium was carried out by a thin-layer chromatographic method using silica gel as the adsorbent and dilute acetic acid as the developer. At first, the separation of nonradioactive Sn(II), Sn(IV), and In(III) ions were tested by using various concentrations of acetic acid solutions. By increasing the concentration of acetic acid, a higher R_f value for In(III) was obtained. On the contrary, Sn(IV) was retained at the original point and Sn(II) advanced with tailing because it was oxidized to Sn(IV) during the development. Accordingly, in order to let Sn stay at the origin, Sn(II) must be oxidized to Sn(IV) by adding H_2O_2 into the sample solution before the development. The best separation of Sn and In was obtained by the solvent consisting of acetic acid : water (1 : 10), by which the R_f values were 0.00 for Sn(IV) and 0.90 for In(III). The spread of Sn(IV) spot was investigated by using sample solutions at various HCl concentration. Sn(IV) spread with increasing the HCl concentration, while In(III) spot stayed at the position of R_f value 0.90 irrespective of the HCl concentration. Accordingly, in order to obtain a clear separation of the spots of these two ions, the HCl concentration of the sample solution must be adjusted at about 1N. The development could be achieved within about 20 min by raising the developing solvent 5 cm high from the original point. Iridium-113m was separated from ^{113}Sn by applying the method mentioned above. The radiochemical purity of the ^{113m}In scratched from the developed plate was identified to be more than 99.9%. By analyzing its decay curve, about 93% of it was extracted from the adsorbent by 5 ml of an acetic acid : water mixture (1 : 10). (auth)

7644 PREPARATION OF ^{237}U AND ^{239}Np TRACERS FROM REACTOR IRRADIATED URANIUM BY EXTRACTION CHROMATOGRAPHY. Narbutt, J.; Smulek, W. (Inst. of Nuclear Research, Warsaw). Nukleonika; 18: No. 8, 375-382(1973).

A method for the separation of radioactive tracers ^{237}U and ^{239}Np from natural U_3O_8 irradiated in a nuclear reactor has been developed. The separation was carried out using a chromatographic column with tri-n-butyl phosphate as the extractant. The elution was carried out with nitric acid solutions of varying concentrations, containing redox and complexing agents. Under the fixed irradiation and cooling conditions it is possible to obtain about 2 mCi of ^{237}U and about 0.7 Ci of carrier-free ^{239}Np from 1 g of the irradiated uranium. (auth)

7645 IRRADIATED NUCLEAR FUELS AS THE SOURCES OF UTILIZABLE TRANSURANIUM ELEMENTS. Eichler, B. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 16: No. 8, 239-244(Aug 1973). (In German).

During nuclear fuel burnup in the reactor core the elements neptunium, americium, and curium are formed in addition to plutonium. Transuranium elements of higher atomic number can be synthesized by irradiation of targets in the reactor. Because of their decay characteristics some transuranium nuclides are appropriate for energy, γ, α, or neutron sources. A review is given of the formation of transuranium elements in the nuclear fuel (except of ^{238}Pu), the possibilities of producing Np, Am, and Cm in the fuel cycle, and the production of ^{238}Pu and transplutonium elements by target irradiation as well as of useful decay properties of transuranium nuclides and their applicability. (auth)

Reactor Fuel Reprocessing

Refer also to abstracts 7699, 8390, 8391, and 8398–8400.

7646 (CONF-721107-, pp 99-130) REVIEW OF MEASURED AND ESTIMATED OFFSITE DOSES AT FUEL REPROCESSING PLANTS. Russell, J. L.; Galpin, F. L. Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Review of offsite doses from fuel reprocessing as measured by EPA and as calculated from several sources of information indicates that radioactive iodine and ^{85}Kr discharges are currently the critical radionuclides in terms of public health. Developmental efforts should be directed to the control of these radionuclides. Discharges of radioactive ruthenium during the solidification process may also be significant; however, operating experience is required to establish decontamination factors. (auth)

7647 (CONF-721107-, pp 153-177) REMOVAL OF ^{85}KRYPTON FROM REPROCESSING PLANT OFF-GAS BY SELECTIVE ABSORPTION. Merriman, J. R.; Stephenson, M. J.; Dunthorn, D. I.; Pashley, J. H. (Union Carbide Corp., Oak Ridge, TN). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

One method of removing Kr and Xe from gas streams which their radioactive isotopes contaminate is selective absorption, using liquid solvents such as fluorocarbons. In this continuous process, the noble gases are preferentially scrubbed from the gas stream and dissolved in the liquid in an absorption operation and then desorbed from the solvent in more concentrated form in a final stripping step. Extensive pilot plant testing, including collection of mass transfer data and determination of the effects of key impurities, has shown that the process has considerable potential for off-gas treatment at fuel reprocessing plants. (auth)

7648 (CONF-721107-, pp 313-337) MANAGEMENT OF FUEL REPROCESSING WASTES AT EUROCHEMIC. Eschrich, H.; van Geel, J.; Detilleux, E. (EUROCHEMIC, Mol, Belg.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The present practices, current developments, and future aspects of the treatment and storage of Eurochemic's fuel reprocessing wastes are reviewed. Data on the production and characteristics of the various types of radioactive effluents, resulting from the different steps of the chemical processing of low and highly enriched uranium fuels, are presented. Recent developments on a low temperature process for the solidification of high-level wastes and on the bituminization process for medium level wastes, are summarized. New procedures are described which are applicable to the treatment of spent tributyl phosphate–kerosene solvents. Finally the future waste management policy at Eurochemic is outlined. (auth)

7649 (CONF-721107-, pp 1033-1044) PROBLEM OF WASTES IN THE PROCESSING OF IRRADIATED FUELS BY THE DRY METHOD. Bourgeois, M.; Perrot, M.; Rochedereux, Y. (CEN, Fontenay-aux-Roses, France). Mar 1973. (In French).

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The procedures of the dry method, and in particular those that make use of the volatilization of fluorides, have the advantage of permitting the reprocessing of irradiated fuels after very short periods of cooling and of leading practically only to wastes in the solid form. The use of gas-tight apparatus necessitated by the handling of corrosive and radioactive gases facilities the packaging of gaseous fission products. The manipulation and storage of the effluents has to be examined from the economic standpoint, the studies carried out up to the present having shown their importance in the cost of reprocessing. (tr-auth)

7650 (CONF-721107-, pp 1057-1079) PROBLEMS POSED BY THE BEHAVIOR AND CONFINEMENT OF FISSION PRODUCTS IN THE COURSE OF REPROCESSING FUELS FROM BREEDER REACTORS. Le Bouhellec, J. (CEA, Marcoule, France); Miquel, P.; Talmont, X. Mar 1973. (In French).

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Future plants for the reprocessing of fuels from breeder reactors will have to use the classical process using tributyl phosphate for the recovery and purification of fissile materials. However, there remain to be resolved the numerous problems related to the confinement of radioactive wastes that are found in the solid state (in the residues from dissolution), in solution (in the nitric acid and alkaline concentrates), and in the gaseous form (iodine, kyrpton, xenon, and tritium). The experiments carried out with the fuels from the Rapsodie reactor have led to some data on the behavior of certain of these wastes and suggest some methods for treating them that will be the object of experiments on the pilot plant scale. (tr-auth)

7651 (CONF-721107-, pp 1111-1131) RECOVERY BY ION EXCHANGE OF TRANSURANIUM ELEMENTS FROM EFFLUENTS FROM A PLANT FOR REPROCESSING OF IRRADIATED FUELS. Arod, J. (CEN, Cadarache, France); Jourde, P. Mar 1973. (In French).

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The recovery of transuranium elements in three types of effluents from a plant for the reprocessing of irradiated fuels was studied by means of ion exchange resins. By means of a treatment of the effluent it is possible to recover in an economical manner about 90% of the transuranium elements (Pu, Np, Am) present. An industrial unit with a nominal output of 1 m^3/h is being studied for the center of La Hague. (tr-auth)

7652 (CONF-731041-3) EFFECTS OF FABRICATION AND IRRADIATION ON THE DISSOLUTION OF $(U,Pu)O_2$ REACTOR FUELS. Goode, J. H.; Fitzgerald, C. L.; Vaughen, V. C. A. (Oak Ridge National Lab., Tenn. (USA)). 1973. 22p. Dep. NTIS $3.25.

From American Ceramics Society nuclear division meeting; San Francisco, California, USA (29 Oct 1973).

LMFBR-type reactors will be fueled with stainless-steel-clad UO_2-PuO_2. Two major concerns in the development of the LMFBR fuel cycle are the recovery of uranium and plutonium and the refabrication of the fuel elements in the minimum practicable time at lowest cost. Effect of fabrication method and irradiation conditions on recovery of the fuel is discussed. The Purex process is used to prepare the feed solutions. Test specimens contained fuels derived from sol-gel, coprecipitated, and mechanically blended oxides. Irradiation levels varied from unirradiated to 100,000 MWd/ton. Solubility of the fuels in terms of the fabrication method is coprecipitated > sol-gel > mechanically blended. Irradiation tends to increase the fuel solubility. (LK)

7653 IMPROVEMENTS IN THE PUREX PROCESS BY ELECTROLYTIC METHODS. Schmieder, H.; Baumgaertner, F.; Goldacker, H.; Hausberger, H. (Kernforschungszentrum, Karlsruhe, Ger.). (1973). vp. (In German).

From 24th IUPAC congress; Hamburg, Germany (2 Sep 1973).

In the Purex process, the separation of plutonium from uranium is accomplished by means of the reduction of Pu(IV) to the practically unextractable Pu(III). In order to avoid the introduction of extraneous corrosive ions, such as Fe(II) or, in the case of Pu-rich fuel, a considerable expansion of process solutions by adding U(IV) as the reduction agent, an in-situ electrolytic procedure has been developed with a cathodic reduction of plutonium. An electrolytic mixer-settler has been built whose constructional principles are explained. The results of some electrolytic countercurrent extraction experiments for the separation of Pu/U, as well as the backextraction of Pu are given. Furthermore, the construction of an electrolytic pulse column is described, and the results of material balance experiments for the different apparatus types are reported. The advantages of the electrolytic process are discussed. (GE)

7654 CONTINUOUS CONVERSION OF URANIUM/PLUTONIUM NITRATES TO OXIDES. Levitz, N.; Grosvenor, D. E.; Vogler, S.; Teats, F. G.; Quattropani, N. (Argonne National Lab., IL). Nucl. Technol.; 20: No. 1, 60-63(Oct 1973).

A continuous fluidized-bed process for the conversion of uranium/plutonium nitrates to oxides is under development to facilitate the recycle of plutonium in the nuclear fuel cycle. The basic process consists of two steps, each performed in a separate fluid-bed reactor: (a) codenitration at 375°C of uranyl nitrate–plutonium nitrate solutions to a UO_3–PuO_2 powder form, and (b) reduction of the UO_3–PuO_2 with hydrogen at 600°C to form UO_2–PuO_2. Pilot-plant denitration studies with uranyl nitrate–plutonium nitrate solutions containing uranium/plutonium ratios of 50 and 4, and plutonium nitrate solution alone are described, as well as reduction of UO_3–PuO_2 powder. Examination of the UO_3–PuO_2 denitration product by autoradiographic and electron microprobe techniques showed that the PuO_2 was distributed in the UO_3 matrix with a high degree of homogeneity. The conversion process appears to be applicable over the entire range of uranium-plutonium concentrations and for plutonium nitrate alone. The suitability of this product for the fabrication of fuel pellets is being studied in cooperation with nuclear fuel manufacturers. (auth)

7655 NEW DEVELOPMENTS IN THE REPROCESSING OF HTGR FUEL ELEMENTS. Kaiser, G.; Merz, E. (Kernforschungsanlage, Juelich, Ger.). (1973). vp. (In German).

From 24th IUPAC congress; Hamburg, Germany (2 Sep 1973).

A report on the research and development program on the reprocessing of irradiated HTGR-fuel elements in the Federal Republic of Germany is given. The first phase consisted of the development of a technically realizable process scheme (head-end, waste-gas combustion, dissolution of the fuel, standardization of the fuel solution, solvent extraction). In the second phase, the process will be tested under condition very similar to operat-

ing conditions. For this purpose, a small demonstration plant has been designed and is now under construction. (GE)

7656 SAFETY IN REPROCESSING AND FABRICATION PLANTS. Gegusch, M. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Kernenergie; 16: No. 3, 68-72(Mar 1973). (In German).

The extended safety aspects are considered which apply to reprocessing plants and fabrication plants as compared with power reactors, in particular by virtue of the uncanned fuel and the immediate handling of plutonium. Principles are presented which have to be observed for the design and safe operation of such plants. Internationally accepted safety regulations are not available. (auth)

7657 INVESTIGATIONS OF NITRIDATION AND HYDROCHLORINATION AS BASIC REACTIONS OF PROCESSES BEFORE REPROCESSING OF NITRIDE NUCLEAR FUELS. I. Nitridation of Nitride Nuclear Fuels. Hermel, W. (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden); Tschirne, G. Kernenergie; 16: No. 7, 225-229(Jul 1973). (In German).

The requirements for decomposition of particles by nitridation of UN or (U, Ce)N with NH_3 were found. A chemical separation of the UN or (U, Ce)N fuel from the steel canning was performed at 640°C for different versions of fuel elements. Nitridation with NH_3 was shown to be appropriate for dismantling UN or (U, Ce)N, material containing up to 20% CeN. (auth)

ENGINEERING

Energy Conversion

7658 SOME PHOTOELECTRICAL CHARACTERISTICS OF PHOTOELECTRIC CONVERTERS WITH A p-i-n STRUCTURE. Azimov, K. S.; Bordina, N. M.; Grigor'eva, G. M.; Kreinin, L. B.; Landsman, A. P. (Inst. of Current Sources, Kishinev, USSR). Geliotekh., Akad. Nauk Uzb. SSR; No. 3, 3-6(1973). (In Russian).

Measurements of the current-voltage characteristics and photo emf in photoelectric converters made of B and P-doped high-resistance silicon and containing p-i-n structures are presented. The high photo emf and current-voltage characteristics with nearly rectangular effective sections suggest the possibility of the creation of highly efficient energy converters of this design. (IAA)

7659 ANALYSIS OF ELECTRICAL CHARACTERISTICS OF THE NONEQUILIBRIUM MHD GENERATOR BY THE FOUR-TERMINAL NETWORK THEORY. Shirakata, H. (Japan Atomic Energy Research Inst., Tokai). Jap. J. Appl. Phys.; 11: No. 12, 1837-1850(Dec 1972).

The basic circuit equivalent to the two-dimensional Ohm's law is expressed as the active network including a current-voltage transducer and a negative resistance. The network for a multi-electrode Faraday generator with the flow of three layers consisting of a free steam layer and two boundary layers is derived by combining the basic equivalent circuits. The steady state solutions of currents, voltages and electron temperatures in the nonequilibrium generator are obtained. In the calculation the loss mechanisms due to electrothermal instability, boundary layer and wall-leakage currents are considered. From the results of the numerical calculation it is found that the instability has an important role in reducing the electron temperature difference between a free stream and a boundary layer and in preventing the boundary layer leakage current. The theoretical and the experimental results are in good agreement. (auth)

7660 EFFECT OF HETEROGENEITY AND HALL CURRENT ON THE MHD POWER GENERATOR. Rudraiah, N.; Murthy, S. N.; Chandrasekhara, B. C. (Univ. of Visvesvaraya, Bangalore, India). Jap. J. Appl. Phys.; 11: No. 9, 1372-1379(Sep 1972).

The investigation considered the influence of Hall effect on the performance of the liquid metal generator using a heterogeneous conducting fluid. The results showed that the combined effect of Hall current and heterogeneity increases the electrical efficiency as well as output power of the generator for a given aspect ratio. (auth)

7661 THERMOELECTRIC ALLOYS. Skrabek, E. A.; Trimmer, D. S. (to Teledyne, Inc.). US Patent 3,762,960, Oct 1973. Filed Date 8 Mar 1972. 8p.

Improved alloys suitable for thermoelectric applications and having the general formula: $(AgSbTe_2)_{1-x} + (GeTe)_x$ wherein x has a value of about 80 and 85, have been found to possess unexpectedly high thermoelectric properties such as efficiency index, as well as other improved physical properties. (Official Gazette)

7662 REACTOR TESTS OF A SINGLE THERMIONIC ELEMENT WITH TUNGSTEN EMITTER AND 0.3-mm INTERELECTRODE GAP. Berzhatyi, V. I.; Gritsaenko, V. P.; Karnaukhov, A. S.; Kirienko, V. P.; Korolev, V. A.; Lyubimtsev, O. I.; Maevskii, V. A.; Mel'nikov, M. V.; Sinyavskii, V. V. Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 11, 1897-1898(May 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 11, 2439-2440(Nov 1972).

A thermionic converter element with a tungsten emitter, a niobium collector, and 0.3 mm interelectrode gap is described. The element is tested in the loop channel of a water-cooled reactor using the ÉS-1-1 experimental setup. The pre-reactor testing procedure is outlined. The emitter temperature is determined from the temperature of a reference point on the end face of the element. The voltage–current characteristics of the element are given for various values of the thermal flux falling upon the emitter. The maximum specific power is 4.2 W/cm^2 at a working voltage of 0.7 V; the efficiency is 9.7% and the maximum emitter temperature 1700°C. The experimental characteristics are in good agreement with theory. (auth)

Facilities and Equipment

Refer also to abstracts 7841, 9366, 9376, 9474, 9502, and 9715.

7663 (AECL-4430) SUCCESSFUL APPLICATION OF SPIRAL WOUND GASKETS REQUIRES ASME CODE REVISIONS. Stevens-Guille, P. D. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

Spiral wound gaskets are widely used in piping and pressure vessel construction. However, there is little published data on their characteristics. The ASME Code rules for gaskets contain design data which have not been revised for the last thirty years. Test results and other specification values indicate that they do not reflect current gasket manufacturing practice. Their use can result in designs which provide insufficient bolt area to seat gaskets less than about 5 in. in diameter. Recommended design values are given for gaskets from $2\frac{1}{2}$ to $20\frac{1}{4}$ in. in diameter. In the long term, the ASME Code Subcommittee on Pressure Vessels is encouraged to consider the adoption of the design rules in the German Standard, DIN 2505. (auth)

7664 (BNWL-SA-4677) EVALUATION OF A HIGH-VOLUME CASCADE PARTICLE IMPACTOR SYSTEM. Sehmel, G. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-1830. 14p. (CONF-731205-2). Dep. NTIS $3.00.

From American Chemical Society 2nd joint conference on sensing of environmental pollutants; Washington, District of Columbia, USA (10 Dec 1973).

Commercially available 20 cfm cascade impactors were evaluated under field sampling conditions for particle sampling bias caused by interstage losses and by non-wind direction sampler orientation. An integrated sampler using an impactor and a wind-direction self-orienting cowl attachment decreased particle sampling bias. (auth)

7665 (BNWL-SA-4749) FLOW PATTERNS IN SODIUM COLD TRAP CRYSTALLIZERS. Lester, D. H.; Bloom, G. R. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1973. 22p. (CONF-731101-35). Dep. NTIS $3.25.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

A simple, inexpensive flow distribution device is required for sodium cold trap crystallizers. The use of inlet mixing nozzles to promote uniform crystallizer flow distribution was investigated. Usually, the inlet to the crystallizer is a straight pipe entering at one point of the annulus. The work compared the conventional inlet nozzle to a 90° elbow pointing horizontally at the top of the annulus. The nozzle length between the bend and the outlet of the nozzle was two pipe diameters. The nozzle diameter was the same as the crystallizer inlet pipe. The flow patterns were evaluated using a water model of the crystallizer tank. The results indicate that modification of the crystallizer inlet pipe to a 90° elbow directed tangentially on the annulus centerline will produce significant improvement of flow distribution and should provide increased crystallizer volume effectiveness. The improvement is more pronounced at low flow rates than at high flow rates. (auth)

7666 (KFK-1842) SUPERHEATED STEAM–CORROSION LOOP FOR THE INVESTIGATION OF THE CORROSION MECHANISM UNDER CONDITIONS OF HEAT TRANSFER AND IN AN ISOTHERMAL STATE. Marten, K.; Vasarhelyi, J. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Reaktorbauelemente). Aug 1973. 79p. (In German). Dep. NTIS (U. S. Sales Only) $6.00.

The selection of appropriate materials for steam superheaters operated by gases or liquid metals and for fuel element claddings used in steam-cooled reactors must be preceded by an investigation of the corrosion mechanism acting upon austenitic materials caused by a superheated steam flow past them with special attention being paid to heat transfer. The investigations called for the construction of a suitable circuit. The facility was designed, constructed and commissioned taking into account specific criteria, such as high-purity steam and very variable system pressures. The circuit represents a closed thermal system. It consists of six test sections accommodating rods with indirect electrical heating for the investigation of the corrosion mechanism under conditions of heat transfer and two test sections used for corrosion investigations of materials in an isothermal state. Since the goal in the design of modern power units is to achieve high system pressures and temperatures, the plant was rated for a maximum pressure of 300 atm. One heating rod test section and the two isothermal test sections were built to withstand a maximum steam temperature of 650°C. The extremely high purity

of the steam and the good hot strength properties raised problems relative to the selection of materials. In respect to instrumentation, special consideration had to be given to minimizing personnel expenditure for plant operation while allowing the instruments to be installed in physically separate areas. (auth)

7667 (LA-5405-MS) STANDARD INSTRUMENT CALIBRATION AEROSOL TEST SYSTEM. Fairchild, C. I.; Ettinger, H. J.; Carson, G. A.; Gettemy, D. J.; Tillery, M. I.; Almich, B. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1973. Contract W-7405-eng-36. 16p. Dep. NTIS $4.00.

A system for testing personal "respirable" samplers in a well characterized coal dust environment is described. Components of the system, contained in one cabinet, include a Wright Dust Feed mechanism, tritide charge neutralizer, aerosol chamber, electrostatic precipitator sampler, and a GCA Respirable Dust Monitor, in addition to air flow plumbing and controls. Employment of this test system to evaluate the performance of personal "respirable" particulate air sampling instruments required variations in aerosol mass concentration with respect to time and space to be less than ±10%. Up to four personal "respirable" dust samples can be simultaneously operated within the coal dust cloud. More than 80 tests of 3 or 4 samplers each showed that variation of total or respirable mass concentration is ±5% within the aerosol chamber. Aerosol aerodynamic size distribution measured with Andersen cascade impactors showed the dust cloud size to be stable within ±6% throughout periods of operation up to 8 h. (auth)

7668 (LA-UR-73-1033) HEAT PIPE THERMAL CONTROL OF IRRADIATION CAPSULES. Deverall, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. Contract W-7405-eng-36. 12p. (CONF-731025-1). Dep. NTIS $3.00.

From 1st international heat pipe conference; Stuttgart, F.R. Germany (15 Oct 1973).

The use of heat pipes to control the temperature of irradiation capsules containing fast breeder reactor structural materials is discussed. (TFD)

7669 METHOD FOR SHEARING SPENT NUCLEAR FUEL BUNDLES. Ehrman, C. S.; Scheib, L.; Worsley, C. S.; Jones, F. J.; Freeborg, R. M. (to Allied Chemical Corp.). US Patent 3,763,770. 9 Oct 1973. Filed date 15 Dec 1970. 10p.

An apparatus for shearing long units, such as nuclear fuel bundles, into pieces of predetermined length for further processing is described. The apparatus comprises a sealable magazine for receiving the bundles, means for urging the bundle forward, a vertical and horizontal gag, or alternately two parallel-acting horizontal gags operated in conjunction with a vertical restraint, for compressing the front portion of the bundle, and a shear blade adjacent to the gags, whereby the nuclear fuel bundle may be urged forward in increments, compressed and sheared into pieces. 6 Claims, 12 Drawing Figures) (Official Gazette)

7670 METHOD, ORIENTATION EQUIPMENT, AND POSITIONING OF A WELDING TORCH. Clara, P.; Foulquier, H.; Vienot, C. (to Commissariat a l'Energia Atomique). French Patent 2,144,048. 29 Jun 1971. 9p. (In French).

A method is described for orientating and positioning a welding torch intended for welding tubes to an element fixed to a reactor vessel following a weld line perpendicular to the axis of the vessel. The method involves rotating the vessel about its axis and positioning the torch inside the tube to be welded (which is situated above and perpendicular to the weld line). The torch is then rotated by the same amount as the vessel, but in the opposite sense, a motor driven part operating in conjunction with the part rotating the vessel being used for this purpose. (FR)

7671 EQUIPMENT FOR MACHINING LARGE DIAMETER PARTS. (to Societe Creusot-Loire). French Patent 2,145,800. 13 Jul 1971. 7p. (In French).

Equipment is described for machining large diameter parts (e.g., nuclear reactor components) on the site where they are to be used. A special feature of the equipment is its movable arm supporting machining heads comprised of several moving parts and pressing against a central pivot and against a circular track (through the intermediate of roller bearings). Means are provided for rotating the movable arm about the central pivot. (FR)

7672 METHOD OF LOCATING A STEAM LEAK IN THE CIRCULATION HEAT EXCHANGER IMMERSED IN LIQUID SODIUM AND THE CORRESPONDING LOCATION EQUIPMENT. Brachet, A.; Lannou, L. (to Electricite de France). French Patent 2,147,348. 23 Jul 1971. 16p. (In French).

A method is presented for locating a tube with a leak among heat exchanger tubes in which the primary fluid is sodium and the secondary fluid is steam or a liquid–steam mixture. The process is particularly suited for the location of microleaks. The technique used consists of detecting hydrogen in the sodium by diffusing this hydrogen across a membrane associated with a mass spectrometer. Improvements made to the initial method enable the bundle of tubes containing the leaking tube to be located with the hydrogen detection apparatus. (FR)

Heat Transfer and Fluid Flow

Refer also to abstracts 8253, 9304, 9357–9360, 9392, 9693, and 9697.

7673 (KFK-1478) HEAT PIPE WITH AN ELECTROSTATIC PUMP. Reiss, F. E. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Aug 1973. 139p. (In German). Dep. NTIS (U. S. Sales Only) $9.00.

Thesis. Submitted to Karlsruhe Univ. (West Germany).

The performance of a heat pipe with an electrostatic pump to return the condensed working fluid to the evaporator was investigated. Theoretic predictions of performance agree with experimental data gained from three different heat pipes using nitrobenzene as a working fluid. (GE)

7674 (UCID–30080) GIFT (GEOMETRIC INPUT FOR TRUMP) COMPUTER PROGRAM FOR CALCULATING ONE-DIMENSIONAL GEOMETRIC INPUT FOR THE TRUMP HEAT TRANSFER CODE. Lobel, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). May 1971. Contract W-7405-Eng-48. 92p. Dep. NTIS $6.75.

TRUMP is a general finite difference computer program for the solution of transient and steady state heat transfer problems. It is a very general program capable of solving heat transfer problems in one, two or three dimensions for plane, cylindrical or spherical geometry. Because of the variety of possible geometries, the effort required to describe the geometry can be large. GIFT was written to minimize this effort for one-dimensional heat flow problems. After describing the inner and outer boundaries of a region made of a single material along with the modes of heat transfer which thermally connect different regions, GIFT will calculate all the geometric data (BLOCK 04) and thermal network data (BLOCK 05) required by TRUMP for one-dimensional problems. The heat transfer between layers (or shells) of a material may be by conduction or radiation; also, an interface resistance between layers can be specified. Convection between layers can be accounted for by use of an effective thermal conductivity in which the convection effect is included or by a thermal conductance coefficient. GIFT was written for the Sigma 7 computer, a small digital computer with a versatile graphic display system. This system makes it possible to input the desired data in a question and answer mode and to see both the input and the output displayed on a screen in front of the user at all times. (auth)

7675 INCIPIENT BOILING SUPERHEAT OF LIQUID METALS IN FORCED CONVECTION: AN INTERPRETATION OF THE VELOCITY INFLUENCE. Scarano, G. (CNEN, Rome). Energ. Nucl. (Milan); 20: No. 8-9, 455-460(1973). (In Italian).

An analysis of studies and experiences on the incipient boiling superheat of liquid metals in forced convection is presented. A new interpretation of the velocity influence is proposed. On the basis of such interpretation, a correlation is developed which appears to be in sufficient agreement with the experimental data available in literature. (15 references) (auth)

7676 DETERMINATION OF EDDY DIFFUSIVITIES IN TUBE BUNDLES WITH CROSS FLOW. Guelich, J. F. (Sulzer Bros. Ltd., Winterthur, Switzerland). Waerme Stoffuebertrag.; 6: No. 2, 92-100(1973). (In German).

By means of tracer tests the eddy diffusivities were measured within an inline tube bundle in cross flow in the range of $7 \times 10^3 < Re < 1.5 \times 10^5$. The test results are represented in the form of a Peclet-number, the upper limit of which can be given the correlation $Pe = 12{,}600 \times Re^{-0.71}$ the confidence limit being about 20 to 30%. In the range of $1.5 \times 10^4 < Re < 10^5$ irregularities were observed in the flow through the bundle, they were characterized by fluctuations of the tracer concentrations, a higher mixing capacity, and an increase in the pressure drop coefficient. The test results, together with the theory given in the paper, provide the basis for the calculation of the temperature profiles perpendicular to flow direction which can occur in cross flow heat exchangers due to perturbations. (GE)

7677 EVALUATION OF FLOW PARAMETERS FROM THE TOTAL COUNT MEASUREMENTS IN THE CASE OF TRACER NON-CONSERVATION. Hubert, J. Z. (Inst. of Nuclear Techniques, Krakow). Isotopenpraxis; 9: No. 3, 91-96(Mar 1973).

A radiotracer method is proposed by which it is possible to evaluate flow parameters (like sorption coefficient, dispersion coefficient, flow velocity or real cross section area of the flow stream) only with the use of integrals of the break-through curves. The integrals may be directly obtained as a result of measurements in the total-count system. The method is applied in the case of an irreversible loss of tracer due to its sorption on the solid phase of the medium or/and to its radiation decay. (auth)

7678 TURBULENT HEAT TRANSFER OF SODIUM IN A CIRCULAR TUBE. Kuroyanagi, T. (Japan Atomic Energy Research Inst., Tokai); Furukawa, K.; Ishiguro, R.; Ochiai, M. Nippon Kikai Gakkai Rombunshu; 38: No. 315, 2897-2905(Nov 1972). (In Japanese).

The effect of thermal boundary conditions on heat transfer was investigated experimentally with sodium flowing through a tube by controlling axial heat flux distribution. The range of sodium temperature was from 190 to 280°C, and the range of Péclet number was from 110 to 400. The Nusselt number in a developed region where heat flux was constant axially, was in good agreement with an accepted empirical formula. In the prior section of the tube, it increased with the Péclet number. When the heat flux distribution was made exponential axially, the tube-wall temperature finally attained constant value in the developed region, where the Nusselt number was also constant. The Nusselt number in this case was lower than that in the constant heat flux. In sinusoidal heat flux distribution, the local Nusselt number varied with the Péclet number, but it was not much influenced by L/D ratio. (JA)

7679 VAPOR–LIQUID CHANGE OF PHASE HEAT TRANSFER BEHAVIOR OF LIGHT HYDROCARBONS AND THEIR MIXTURES. Clements, L. D. Jr. Norman, OK; Univ. of Oklahoma (1973). 137p. University Microfilms Order No. 73-23,904.

Thesis (Ph. D.).

A tripartite study of the effects of pressure and composition on vapor-liquid change of phase heat transfer in light hydrocarbons is presented. The separate phenomena of natural convection and nucleate pool boiling in a saturated liquid, the burnout heat flux, and film condensation in a vertical reflux condenser were investigated. The pure components propane, n-butane, and n-pentane and the binary systems propane-n-butane and propane-n-pentane were used. The nucleate boiling data showed a pressure behavior consistent with that noted by previous investigators and a marked composition dependence of the boiling temperature difference. The natural convection data showed no particular pressure influence and a composition dependence analogous with that in nucleate boiling. A correlation which allows prediction of the nucleate boiling ΔT for a pure component using the desired heat flux and the critical properties of the material was developed. In addition, the composition dependence of the boiling temperature difference was related to the mixture relative volatility. A correction factor which accounts for mixture behavior in natural convection and nucleate boiling is proposed. The film condensation data showed no strong influence of either pressure or composition. The latter result is consistent with other investigators. The data appear to be in the turbulent flow regime and a correlation for the film condensation data is presented. The burnout data show the classic dependence on pressure and the pure component data agree well with the Moissis and Berenson correlation. There was a definite mixture effect present, with mixtures exhibiting burnouts as much as twice those of the pure components. It was found that the relative volatility also represented the composition dependence of burnout well. A modification of the Moissis and Berenson correlation is proposed for use in predicting mixture burnouts. (Diss. Abstr. Int., B)

Materials Testing

Refer also to abstract 7833.

7680 (AECL-4590) DEVELOPMENT OF A HYDRAULIC BURST TEST APPARATUS FOR FUEL CLADDING. Roberts, R. S. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

In 1964, a hydraulic burst test rig for testing fuel sheathing was designed and built by Canadian General Electric at Peterborough. A similar rig was subsequently ordered by Atomic Energy of Canada Limited, and was received early in 1965. The apparatus has since been extensively modified at the Chalk River Nuclear Laboratories with an electric pump, an X-Y recorder, and a new furnace, which makes it a more flexible, mechanized apparatus. It has been used extensively in the fuel cladding program to test both unirradiated and irradiated specimens. Design and use of the machine are described. (auth)

7681 (SLA-73-964) RADIOGRAPHIC LAMINOGRAPHY. Hasenkamp, F. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 23p. Dep. NTIS $3.25.

A facility has been developed for radiographic imaging of a single plane in an object. The laminographic process is accomplished by simultaneous motion of the object and the film during exposure. Multiple planes can be imaged simultaneously. The advantages of laminography are that of eliminating confusing detail contained in some normal radiographs and in providing a precise measurement of the location of a detail within an object. This report describes the device developed at Sandia Laboratories and discusses its capabilities. (auth)

7682 NONDESTRUCTIVE TEST DEVICE USING RADIATION TO DETECT FLAWS IN MATERIALS. Heffan, H.; Bergh, E. M.; Mauch, J. W.; Sawick, W. J. (to Secretary of the Navy). US Patent 3,766,387. 16 Oct 1973. Filed date 11 Jul 1972. 8p.

A nondestructive test device for detecting flaws such as boundary separation between the liner and propellant of missile motors and the like is described. The device includes a rotatable table upon which the motor to be tested is mounted. A horizontal movement carriage is mounted on a vertical movement carriage. Mounted upon the horizontal movement carriage is a radiation source and a detector. The source emits radiation that passes through the motor and is received by the detector. The motor is rotated and defects cause an increase in radiation received by the detector resulting in a deviation from the normal signal. This detected deviation is electronically processed and recorded. A radiation absorber, a rotating slotted helix for providing a radiation window, and a helix angulation control are employed to provide the necessary controls and desired information. (8 Claims, 6 Drawing Figures) (Official Gazette)

7683 RADIOGRAPHIC EXAMINATION OF PIPE JOINTS. Redmayne, I. G. (to B. I. X. Ltd.). US Patent 3,764,806. 9 Oct 1973. Priority Date 31 Jan 1967, United Kingdom of Great Britain and Northern Ireland. 8p.

The specification of this application discloses improved methods and apparatus for radiographically examining welded joints in pipelines, during laying of such pipelines, using a signal source outside the pipe to automatically control the positioning of a self-propelled vehicle carrying a radiation source inside the pipe, such vehicle utilizing a source of compressed air, provided for the internal line-up clamp necessary in pipeline laying, to generate electricity for powering the electrical circuitry of the vehicle, thereby avoiding the necessity of trailing power supply cables in the pipeline in addition to the compressed air line. (Official Gazette)

7684 CONTRIBUTION TO THE X-RAYING OF TIRES. Krebs, W. Kaut. Gummi Kunstst.; 26: No. 5, 191-193(1973). (In German).

In the field of x-ray technique with a fluorescent screen or image intensifier in the radiography of steel cord rubber tires, the following are discussed: the simultaneous radiography of a closed tire cross section with an x-ray tube, x-ray testing equipment for unfinished parts in x-ray techniques using films, x-ray photometry, x-ray microradiography and the testing of tires by gamma radiography. (GE)

7685 TESTING OF THIN TUBES USING ULTRASOUND. Selection of Test Frequency. Perdijon, J. (CEN, Grenoble, France). Rev. Met. (Paris); 70: No. 7, 551-562(Jul 1973). (In French).

In the testing of tubes by ultrasound, a rejection threshold is generally fixed using a reference standard having well-defined defects operating conditions are never imposed. The variation in the defect-finding capacity of the method with frequency was studied for the case of 1317 tubes for EL 4. A 2 MHz frequency allowed tubes to be tested that could not be tested at 4 MHz as a result of background noise due to grains having an index of 3 or 4. Unfortunately, it may be that some serious internal defects remain undetected while slight external defects lead to spurious signals. (FR)

7686 DEVICE AND PLATE FILM BATCH PERMITTING AUTORADIOGRAPHY. Removille, J.; Schmit, F. (to Gradel S. A.). Luxemburgian Patent 64,613. 19 Jan 1972. (In French).

Available from the Commission of European Communities, Luxembourg.

The invention relates to a device and to a plate film batch permitting autoradiographic recordings in the interior of containers enclosing a specific atmosphere. The device has a support capable to lodge the film batch between a sealing joint and a locking element. The batch consists of a smooth closed envelope containing the film and the developer reservoir. Further, the batch is equipped with a draw nob clamped on one rim of the batch, and a conical push knob on the opposite rim. (auth)

7687 DYNAMIC RADIOGRAPHY. Kenney, E. S.; Jacobs, A. M. (to Research Corp.). U. S. Patent 3,769,507. 30 Oct 1973. Filed date 25 Aug 1971. 16p.

A dynamic radiography system is described for examining an optically opaque object containing radiation scattering centers by irradiating the object with penetrating radiation to cause radiation scattering by these scattering centers, causing periodic vibration of these scattering centers, detecting radiation scattered by the scattering centers in the object along at least two noncongruent detection channels which are at an angle with each other and which intersect at a common volume within the object, and correlating the outputs of the detectors with a frequency parameter of the vibration to derive thereby information of internal physical and mechanical characteristics of the object. (Official Gazette)

Nuclear Explosions

7688 (NVO-289-11) GENERALIZED MODELS OF EXPLOSION-WAVE GENERATION. Final Report. Divoky, D. (Tetra Tech, Inc., Pasadena, Calif. (USA)). Jun 1973. Contract AT(26-1)-289. 50p. Dep. NTIS $4.00.

Generalized models of explosion wave sources are presented. Two additions to the Kranzer-Keller type model have been made. First, a formulation is given which accounts for an initial velocity (or acceleration) field in addition to an initial free-surface deformation. Second, a model is developed to account for wave generation by a travelling pressure distribution on the surface. This model is demonstrated by application to simple step-function pressure distributions. A separate addendum describes an application to field observations and shows that the model is capable of yielding reasonable predictions. (auth)

7689 (UCID-16390) STRAIN SEISMOMETER DATA FROM THE ALMENDRO EVENT AT NTS. Olsen, C. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1973. Contract W-7405-eng-48. 40p. Dep. NTIS $4.00.

The ALMENDRO Event was conducted on Pahute Mesa at NTS, and was announced as an intermediate yield event (200 to 1000 kt). Strainmeter records were obtained at three locations in Yucca Flat. One recording site was a triaxial station; the other two were two component stations. The station parameters and pertinent data relating to ALMENDRO are summarized in tabular form. (TFD)

7690 (UCRL-74868) RIO BLANCO GAS QUALITY ANALYSIS AND EVALUATION PROGRAM STATUS REPORT. Smith, C. F.; Taylor, R. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 9 Nov 1973. 18p. (CONF-731101-29). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

A summary of the information currently available from the efforts of the Rio Blanco gas quality analysis and evaluation program is presented. (TFD)

7691 RADIATION DOSES FROM HYPOTHETICAL EXPOSURES TO RULISON GAS. Barton, C. J. (Oak Ridge National Lab., TN); Moore, R. E.; Hanna, S. R. Nucl. Technol.; 20: No. 1, 35-50(Oct 1973).

Production testing of the Rulison well, the second natural gas well developed by use of nuclear explosives, was completed in April 1971. The hypothetical radiation exposure situation that would have resulted if the gas originally present in the well had been withdrawn at a rate to give 1 million ft^3/day after dehydration and CO_2 removal and the processed gas distributed by two gas companies to small communities in the area near the well is examined. Tritium and ^{85}Kr are the principal radionuclides present in the gas from the Rulison well. The average whole body dose from inhalation and skin absorption of tritium to members of the exposed public served by one of the gas transmission companies was estimated to be 0.6 mrem for the first year of gas use. The principal source of this hypothetical dose was exposure in the home to tritiated water vapor from cooking with unvented gas ranges. Use of unvented home heaters was not considered credible. Whole body doses from exposure to tritiated water vapor dispersed in the atmosphere of the same communities averaged 0.1 mrem for the first year. Continuing use of gas at the same rate would reduce the average dose to 0.02 mrem in the second year and to < 0.01 mrem in the third year as contaminated gas in the chimney is diluted by the influx of uncontaminated gas from the surrounding formation. Whole body doses from ^{85}Kr were estimated to be ~2% of the tritium whole body doses. (auth)

7692 GEOTHERMAL-NUCLEAR ENERGY RELEASE AND RECOVERY SYSTEM. Van Huisen, A. T. US Patent 3,765,477. 16 Oct 1973. Filed date 21 Dec 1970. 10p.

A system for mining geothermal energy utilizing the detonation of a deeply buried nuclear device such as a nuclear fusion bomb or a nuclear fission bomb to produce a chimney cavity and fractures in a rocky geothermal stratum is described. Heat exchange fluid is introduced into the cavity and is transferred to flood a higher permeable stratum closer to the surface of the earth. Heat exchangers are introduced into the flooded zone to transfer heat and energy to the surface for utilization. (11 Claims, 3 Drawing Figures) (Official Gazette)

7693 METHOD AND EQUIPMENT FOR MEASURING THE POWER OF A NUCLEAR EXPLOSION. Casejuane, R.; Rochard, Y. (to Commissariat a l'Energia Atomique). French Patent 2,136,904. 7 May 1971. 8p. (In French).

A method is presented for measuring the power of a nuclear explosion from recordings of the illumination as a function of time, the time origin being the initiation of the nuclear explosion. The time interval $t_1 - t_n$ corresponds to the reoccurrence of the same value of illumination and is measured for a predetermined value of n. At least two curves are simultaneously displayed, which represents the variations in illumination as a function of time for different time scales having the same n ratio. The point of intersection of these curves is determined, the abscissas of which correspond to times of t_1 and t_n on each curve. (FR)

Safety Engineering

Refer also to abstract 7656.

ENVIRONMENTAL AND EARTH SCIENCES

Minerals and Ores

Refer also to abstract 9692.

7694 (JINR–P13-7249) HYDROTHERMS AND SUPER-HEAVY ELEMENTS. Chuburkov, Yu. T.; Lebedev, L. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The most perspective region for the search for super-heavy elements in the USSR is the Caspian Sea, in particular, the hydrothermal ore-bearing system is Cheleken. Of interest, from the above point of view, are also the hydrotherms in California (Salton Sea region), in the Red Sea (Atlantis II and Discovery), and in New Zealand. (auth)

7695 RESEARCH IN THE GEOLOGICAL SCIENCES. Publications Series B, No. 7. London; Natural Environment Research Council (1973). 120p.

A consultative document is presented that comprises reports from eleven NERC geological sciences working parties. The eleven reports are from the working parties in the following fields: data processing in geology and geophysics; engineering geology; geochemistry (pure and applied); geochronology and isotope geology; geophysics (pure and applied); geotectonics and crustal studies; marine geology and geophysics; mineralogy, petrology and crystallography; mining and economic geology; paleontology and stratigraphy; sedimentology. The report of the working party on geochronology and isotope geology was in NSA scope and a separate abstract was prepared for it. (UK)

For an abstract of an individual section see: 7724.

7696 URANIUM CONCENTRATION AND DISTRIBUTION IN SIX PERIDOTITE INCLUSIONS OF PROBABLE MANTLE ORIGIN. Haines, E. L. (California Inst. of Tech., Pasadena); Zartman, R. E. (Earth Planet. Sci. Lett.; 20: No. 1, 45-53(Sep 1973).

Fission-track activation was used to investigate uranium concentration and distribution in peridotite inclusions in alkali basalt from six localities. Whole-rock uranium concentrations range from 24 to 82 ng/g (1 ng = 10^{-9} g). Most of the uranium is uniformly distributed in the major silicate phases, olivine, orthopyroxene, and clinopyroxene. Chromian spinels may be classified into two groups on the basis of their uranium content, having either less than 10 ng/g or 100–150 ng/g U. In one sample accessory hydrous phases, phlogopite and hornblende, contain 130 and 300 ng/g U, respectively. The contact between the inclusion and the host basalt is usually quite sharp. Glassy or microcrystalline veinlets found in some samples contain more than 1 μg/g (1 μg = 10^{-6} g). Very little uranium is associated with microcrystals of apatite. The results agree with some earlier investigations, that concluded that suboceanic peridotites contain too little uranium to account for normal oceanic heat flow by conduction alone. (auth)

7697 PRESENT AND FUTURE PICTURE OF URANIUM IN THE WORLD. Com. Naz. Energ. Nucl., Notiz.; 19: No. 6, 81-83(Jun 1973). (In Italian).

A study of the status of uranium supplies in the world is presented. (auth)

Radioactive Effluents

Refer also to abstracts 7646, 7741, 7744, 7976, and 9667.

7698 (CONF-721107-, pp 37-52) ATOMIC ENERGY AND THE ENVIRONMENT. Marley, W. G. (National Radiological Protection Board, Harwell, Eng.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Radiation doses used as criteria for protecting populations from the effects of a nuclear power program are reviewed. These include the levels recommended by ICRP for doses to the population and the acceptable variations in the natural background. The latest available data on risks of radiation-induced biological effects are discussed. Estimates of the radiation doses to the public from the current nuclear power programs are very low and even the predicted values in the year 2000 are only 2×10^{-3} of the dose from natural background. This level of dose taken in conjunction with present knowledge of risks shows that the biological impact on the world population is negligibly small. Finally, a comment is made on the sources of population exposure from radioactivity associated with possible thermonuclear reactors. (auth)

7699 (CONF-721107-, pp 131-151) FUTURE IMPLICATIONS OF SOME LONG-LIVED FISSION PRODUCT NUCLIDES DISCHARGED TO THE ENVIRONMENT IN FUEL REPROCESSING WASTES. Bryant, P. M.; Jones, J. A. (National Radiological Protection Board, Harwell, Eng.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Current reprocessing practice leads to the discharge to the environment of virtually all the ^{85}Kr and tritium, and a large fraction of the ^{129}I, formed as fission products in reactor fuel. As nuclear power programs expand the global inventory of these long-lived nuclides is increasing. The radiological significance of these discharges is assessed in terms of radiation exposure of various population groups during the next few decades. The results of this assessment show that ^{85}Kr will give higher dose rates than tritium or ^{129}I, but that on conventional radiological protection criteria these do not justify taking action to remove ^{85}Kr from reprocessing plant effluents before the 21st century. (auth)

7700 (HW-81306) ANALYSIS OF WASTE RELEASED BY SEEPAGE TO THE COLUMBIA RIVER FROM THE 1301-N CRIB. Nelson, R. W. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). Apr 1964. Contract AT(45-1)-1350. 34p. Dep. NTIS $3.75.

The 1301-N crib is designed to receive diverted primary coolant from the N-Reactor when a fuel element fails. Information on the rate of release of fission products and concentrations in the Columbia River was needed to evaluate the long-term public safety. Methods are described for predicting the arrival-time distribution of wastes to the river. These methods are specifically applied to provide estimates of the long-term maximum activities of ^{131}I in the river as a result of the disposals to the 1301-N crib. Other radionuclide activities may be obtained through use of the basic flow system results. The methods, presented in detail, provide conservative prediction of river contamination levels after long-term operation. (CH)

7701 (INIS-mf-575) ORIGIN, NATURE, AND RELATIVE IMPORTANCE OF RADIOACTIVE WASTES PRODUCED IN SEVERAL OPERATIONS OF THE FUEL CYCLE. Osipenco, A. (Association des Ingenieurs Electriciens, Liege (Belgium)). 1973. 19p. (In French). INIS.

From international conference on nuclear energy and the environment; Liege, Belgium (22 Jan 1973).

The comparison of various undertakings related to nuclear science and technology show that the use of nuclear power plants for the production of electrical energy is the principal source of radioactive wastes. The nature and the importance of solid, liquid, and gaseous radioactive residues produced in the course of the successive stages of the fuel cycle used in power reactors are considered. An estimation of the development foreseen for the succeeding decades is given insofar as possible. Finally, the case of an accident is envisaged: the foreseeable accidents can lead to a dispersion of radioactive substances and the corrective actions of decontamination produce generally very large quantities of radioactive wastes, both solid and liquid. (tr-auth)

7702 (NP-19896) PRODUCTION AND RELEASE OF TRITIUM BY NUCLEAR POWER PLANTS AND REPROCESSING PLANTS AND THE EXPECTED RADIOLOGICAL BURDEN TILL THE YEAR 2000. Grathwohl, G. (Karlsruhe Univ. (TH) (F.R. Germany); Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Feb 1972. 88p. (In German). Dep. NTIS (U. S. Sales Only) $6.50.

Natural tritium production is summarized in this report together with the yields from nuclear weapons and nuclear facilities. Specific production rates and the consequent release rates representative of time are evaluated for the different types of nuclear power plants. Release rates from fuel reprocessing plants are also included. An estimation of tritium inventory from fusion reactors is also attempted. Based on the forecasted onset of nuclear facilities till the year 2000, the time-dependent production rates as well as the global inventory are calculated. On the strength of the release rates and a global mixture in the hydrosphere, tritium concentration in water is evaluated. For the German river system the tritium-take up capacity is estimated. (auth)

7703 STIRBT UNSER BLAUER PLANET. Die Naturgeschichte Unserer Uebervoelkerten Erde. (Is Our Blue Planet Dying. The Natural History of our Overpopulated Earth). Haber, H. Stuttgart; Deutsche Verlags Anstalt (1973). 140p. DM 20,-.

The future of both mankind and earth is discussed from a scientific point of view in popular language. As key problem,

the population explosion is emphasized and its various aspects are outlined. Production of food and energy for the increasing population will inevitably pollute the planet. For air, soil, and water, the self-decontamination capacities are discussed with regard to dust, fertilizers, pesticides, other toxic chemicals, and radioactive waste from power plants. With great urgency, appropriate technical and legislative actions must be taken to avoid a rapidly approaching disaster. (HBG)

7704 HISTORY AND PRELIMINARY INVENTORY REPORT ON THE KENTUCKY RADIOACTIVE WASTE DISPOSAL SITE. Clark, D. T. (Kentucky State Dept. of Health, Frankfort). Radiat. Data Rep.; 14: No. 10, 573-585(Oct 1973).

The Kentucky radioactive waste disposal site, operated by the Nuclear Engineering Company, Incorporated, has been in operation since March 1963. As of January 1, 1972, approximately 0.71 million cubic meters of waste, containing 1,153,333 curies of byproduct material, 208,903 grams of special nuclear material, and 39,493 kilograms of source material, have been disposed of at this facility. Due to the relatively long period of operation and the large quantities of radioactive material involved, a detailed inventory of two of the largest pits at the site was made, based on available disposal records. This report contains a brief history of this facility and a summary of the inventory results. (auth)

Radioactivity Monitoring and Transport

Refer also to abstracts 7701 and 7976.

7705 (LBL-2039) PLUTONIUM: A REVIEW OF MEASUREMENT TECHNIQUES FOR ENVIRONMENTAL MONITORING. Budnitz, R. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1973. Contract W-7405-eng-48. 9p. (CONF-731112-11). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

An overview is provided of the techniques for measuring plutonium in various media. The emphasis is on measurements for surveillance and protection in environmental and occupational situations. Overviews are first provided for the characteristics of, sources of, and typical levels of plutonium concentrations. The various measurement techniques are then discussed. (auth)

7706 (NP-19871) ENVIRONMENTAL RADIOACTIVITY AND RADIATION BURDEN. Annual report, 1971. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)). 1972. 175p. (In German). Dep. NTIS (U. S. Sales Only) $10.75.

In cooperation with the federal and state governments of West Germany, various monitoring stations and laboratories present their findings about the radioactivity in air, rain, rivers, seas, waste water, soil, potable water, milk, cereals, meat, fish, and other foodstuff. The report also covers personnel dosimetry, incorporation measurements, and radiation injuries during the handling of radioactive material. Findings are presented in numerous tables and graphs with brief summarizing comments. (HBG)

7707 (SSI-1972-9) ANNUAL REPORT TO THE SWEDISH ATOMIC RESEARCH COUNCIL, 1971. Lindell, B.; Snihs, J. O.; Swedjemark, G. A. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Jan 1972. 20p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

The research consisted of investigations on low activity metabolism of radioactivity in man, naturally occurring α-emitters particularly in air, and various problems related to widespread environmental contamination and radioecology. The aim of the studies of the α-emitters is to develop methods of measurements of low levels of radium-226 and radon-222 in the human body by measurements of the exhaled air and to measure naturally occurring radioactive substances in the environment (with special emphasis on radon in mines). Other projects include a follow-up of the environmental situation with regard to radioactive fallout, particularly in milk. Measurements were made with various types of equipment for low-β-counting and γ-spectrometry, including whole body counting. Studies were made of correlations between various quantities such as milk activity and the content of cesium-137 in meat and pork. Levels of environmental contamination in Sweden for 1971 are reported. (SW)

7708 (SSI-1973-8) ANNUAL REPORT TO THE SWEDISH ATOMIC RESEARCH COUNCIL, 1972. Lindell, B.; Snihs, J. O.; Swedjemark, G. A.; Bengtsson, G. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Jan 1973. 22p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.25.

The research for which account is given in this report consisted of investigations on low activity metabolism of radioactivity in man, naturally occurring α-emitters particularly in air, and various problems related to widespread environmental contamination and radioecology. The aim of the studies of the α-emitters is to develop methods of measurements of low levels of radium-226 and radon-222 in the human body by measurements of the exhaled air and to measure naturally occurring radioactive substances in the environment (with special emphasis on radon in mines). Other projects include a follow-up of the environmental situation with regard to radioactive fallout, particularly in milk. Measurements were made with various types of equipment for low-β-counting and γ-spectrometry, including whole-body counting. Studies were made of correlations between various quantities such as milk activity and the content of cesium-137 in meat and pork. Levels of environmental contamination in Sweden for 1972 are reported. A research program has been started on the use of plastic scintillators for absorbed dose determination. The calibration will be performed using total absorption of the beta radiation from known radioactive sources. A literature survey indicates a possible accuracy of about one per cent in the absorbed dose determination. Experiments with photodiodes have shown that under certain conditions their inherent sensitivity to ionizing radiation will make them unsuitable for the light detection. (SW)

7709 DATA. Section IV. Other Data. Radiat. Data Rep.; 14: No. 10, 620-651(Oct 1973).

Data are presented on the ^{90}Sr to Ca ratios of human vertebrae in New York City and San Francisco during 1971. Data on environmental radioactivity at Lawrence Livermore Laboratory during 1971 included: gross alpha and beta activity in air, gamma spectral measurements of perimeter air filters; ^{95}Zr-^{137}Cs activity ratios on air filters from perimeter samplers; ^{238}Pu, ^{239}Pu, ^{235}U, and ^{238}U concentrations in perimeter air filters; inhalation doses of radionuclides; activity levels of various radionuclides in soil; gross alpha and beta, tritium, and ^{90}Sr activity in sewage treatment samples; gross beta radioactivity in water samples; tritium activities in water samples; radionuclide activities in vegetation samples; and radionuclide activity in milk samples. Data on environmental radioactivity at Shippingport Atomic Power Station during 1971 included total activity and tritium activity in the Ohio River from liquid and gaseous radioactive waste discharges; radioactivity in silt samples from the Ohio River bottom; and detection of external gamma radiation exposures using film badges. A report of seismic signals, presumably from a Soviet underground nuclear explosion in September, 1973, is also included. (HLW)

Atmosphere

7710 (IITRI-C-6105-25) SCAVENGING STUDY OF SNOW AND ICE CRYSTALS. Quarterly Report, July 1-September 30, 1973. Knutson, E. O. (IIT Research Inst., Chicago, Ill. (USA)). 9 Oct 1973. Contract AT(11-1)-578. 19p. Dep. NTIS $3.00.

The empirical base for a concise and useful prediction model for aerosol washout by snow is identified. It includes data obtained by IIT Research Institute, by Reiter and Carnuth, by Itagaki and Koenuma, and by Wolf and Dana. The data on aerosol washout by snow comes in two forms: data on scavenging efficiency of individual snow crystals or flakes and data on scavenging by an integrated sample of snow. The calculations necessary to unite these two types of data are outlined and the sources of the required supplementary data are identified. (auth)

7711 (LURI-1973-4) γ SPECTROMETRIC FIELD STUDIES. II. Finck, R.; Liden, K.; Persson, B. (Lund Univ. (Sweden). Radiofysiska Institutionen). Feb 1973. 43p. (In Swedish). Dep. NTIS (U. S. Sales Only) $4.25.

An examination is made of the possibilities of doing in situ measurements of ground activity and exposition rates from natural and artificial radionuclides using aerial surveying and Ge(Li) semiconductor detectors. Energy absorbtion peaks are registered for γ radiating radionuclides found in the environment. Both ground-level radioactivity and exposition rates above ground level are calculated. A calibration method for the measurements is described. (SW)

7712 DATA. Section III. Air and Deposition. Radiat. Data Rep.; 14: No. 10, 610-619(Oct 1973).

Data are presented on gross beta radioactivity in surface air and precipitation collected at selected locations in the USA during June, 1973. Data are also included on gross beta radioactivity in surface air and precipitation in Canada, and Central and South America during June, 1973. Data are reported on gross beta radioactivity in airborne particulates collected at selected stations in California during June, 1973. (HLW)

Soil

7713 (BNWL-1718) ONE-DIMENSIONAL MODEL OF THE MOVEMENT OF TRACE RADIOACTIVE SOLUTE THROUGH SOIL COLUMNS: THE PERCOL MODEL. Routson, R. C.; Serne, R. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1972. Contract AT(45-1)-1830. 49p. Dep. NTIS $3.00.

A one-dimensional mathematical model, PERCOL, has been developed to predict the movement of radionuclides through porous media as a function of measurable chemical parameters of the media. Laboratory column studies were conducted to verify the model. System parameters considered include soil type, radionuclide type, waste composition, flow rate, column length, and soil saturation. The agreement between measured radionuclide movement and that predicted by the model is considered good. (auth)

7714 SOURCES OF MARINE STRONTIUM AND THE $^{87}Sr/^{86}Sr$ RATIO IN THE SEA THROUGHOUT PHANEROZOIC TIME. Brass, G. W. New Haven; Yale Univ. (1973). 118p. University Microfilms Order No. 73-24,944.

Thesis (Ph.D.).

The $^{87}Sr/^{86}Sr$ ratio in the sea has varied over geologic time with several maxima and minima. The supply of strontium to the sea from weathering of continental rocks is the cause of the measured changes. Seven weathering profiles in New Zealand were sampled for this study. Rubidium and strontium, Rb/Sr ratios, and $^{87}Sr/^{86}Sr$ ratios were measured. Isochron-like arrays are present on graphs of $^{87}Sr/^{86}Sr$ vs. Rb/Sr ratios, but they are not interpreted as representing any actual age. The leaching of common strontium from rubidium poor unstable minerals is more efficient than the leaching of radiogenic strontium from stable rubidium rich minerals. A simple model shows that isochrons from older events (source ages or deposition ages) may be altered by weathering. One consequence of this model is that the dissolved strontium weathering from a rock is only slightly less radiogenic while the residual material is much more radiogenic. If the average continental crust has a $^{87}Sr/^{86}Sr$ ratio of 0.721, we might expect streams to be less radiogenic and pelagic clays much more radiogenic. In a compilation of river waters, mostly on old shield terrains, only 9% have $^{87}Sr/^{86}Sr$ ratios > 0.720 while in Dasch's (1969) data on pelagic clays, 39% are > 0.720. The Hubbard Brook, New Hampshire watershed was tested in order to calculate a mass balance for strontium but uncertainties in the input of marine aerosols and the relatively low rate of weathering only allow the conclusion that the $^{87}Sr/^{86}Sr$ ratio weathering from the local rock and till is very similar to the $^{87}Sr/^{86}Sr$ ratio in those materials. By a simple mass balance calculation, the effect of weathering on the $^{87}Sr/^{86}Sr$ ratio can be assessed with a few assumptions about the cycle. It is clear that the strontium weathering from silicates was quite unradiogenic 200 my ago and has become increasingly more radiogenic until the present. (Diss. Abstr. Int., B)

Water

7715 DATA. Section II. Water. Radiat. Data Rep.; 14: No. 10, (Oct 1973).

Data are presented on the tritium content of drinking water and precipitation samples collected at selected locations in the USA during April through June, 1973. Samples were collected daily and analyzed monthly. Quarterly samples of surface water were collected and analyzed for tritium content. (HLW)

7716 RESIDENCE TIME OF THORIUM IN SURFACE SEA WATER AND ITS IMPLICATIONS REGARDING THE RATE OF REACTIVE POLLUTANTS. Broecker, W. S.; Kaufman, A.; Trier, R. M. (Columbia Univ., Palisades, NY). Earth Planet. Sci. Lett.; 20: No. 1, 35-44 (Sep 1973).

The activity ratio of $^{228}Th/^{228}Ra$ in the open surface ocean averages 0.21. This suggests that thorium is removed from surface water in about 0.7 yr. As plant matter is cycled within the surface sea on a similar time scale, the suggestion is made that highly reactive compounds are inadvertently removed by plants in their quest for the critical nutrients, nitrate and phosphate. Combined with the coefficient for horizontal eddy diffusivity obtained from the distribution of ^{228}Ra in surface seawater this result provides a basis for the prediction of the distribution of "reactive" pollutants released to the surface sea from coastal areas. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 8066, 8078, and 8098.

7717 (CEA-R-4530) EXPERIMENTAL STUDY OF THE ACCUMULATION OF ANTIMONY-125 BY SOME GROUPS OF MARINE ORGANISMS. Amiard, J. C. (CEA Centre de La Hague, 50 – Cherbourg (France). Service de Recherches Toxicologiques et Ecologiques). Dec 1973. 14p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

The uptake of ^{125}Sb by some twenty species representative of most marine organisms was followed in laboratory conditions. The concentration factors were low, in the range of 1 to 20, and decreased as a function of the complexity of the organisms, the highest values being 17 and 6 for algae and animals respectively. Steady-state conditions were observed for some species. It was noticed that the values of the concentration factors obtained under laboratory conditions were lower than those found for the stable isotopes in field conditions. (FR)

7718 (NP-19900) ACTIVITY MEASUREMENTS OF MILK, FODDER, EXCREMENT, WATER, AND SOIL FROM FARMS IN SAMNANGER AND MATRE SUMMER AND AUTUMN 1970. Holm, A. W. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Dec 1970. 32p. (In Norwegian). Dep. NTIS (U. S. Sales Only) $3.75.

An analysis of results from measurements summer and autumn 1970 of cesium-137 in drinking water, fodder, milk, excrement, and soil sampled in the Samnanger and Matre districts on the west coast of Norway are presented. The farms have been separated into three groups, based on farming and feeding methods. The highest levels of cesium-137 are found where extensive farming methods are used. Generally there is an increase in cesium-137 content in milk and excrement in the beginning of the grazing season and a decrease in the autumn. The lowest levels are found where intensive farming methods are used. (auth)

7719 (NP-19901) CESIUM-137 IN MEAT FROM IMPORTANT MEAT PRODUCING ANIMALS IN NORWAY MEASURED IN SPRING 1971. Harvold, U. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Sep 1971. 21p. (In Norwegian). Dep. NTIS (U. S. Sales Only) $3.25.

Measurements have been made of the concentration of ^{137}Cs in meat from important meat producing animals in Norway. During the spring of 1971, gamma spectrographic measurements of 105 meat samples from various parts of the country were carried out at the Norwegian Defence Research Establishment. The animals from which the samples were taken were all slaughtered during February – March. The content of ^{137}Cs was in the case of pig, cattle, and horsemeat at the same level as in the years 1960 to 1962. In reindeer-meat, the concentration of ^{137}Cs has been constant since 1966. Compared with the last 3 years' spring measurements, the concentration of ^{137}Cs in mutton shows a slight decrease. The amount of ^{137}Cs in goat meat is the lowest ever recorded at the Norwegian Defence Research Establishment. (auth)

7720 TRANSFER OF RADIOACTIVE POLLUTION FROM CONTAMINATION SOURCES TO MAN. Bittel, R. (CEN, Fontenay-aux-Roses, France). Agriculture (Paris); No. 366, 166-169 (Jun 1973). (In French).

The health physics department of the CEA undertook the following studies in the framework of investigations on the consequences to man of radioactive pollution in the environment: experimental studies of factors affecting the degree to which human beings are contaminated; experimental study of the mechanisms involved in the transfer of radioactive pollutants up to man. The transfer chains from the locations in the environment where the radionuclides appear up to man may be short, average-lengthed, or long. (FR)

7721 RADIOECOLOGY AND THE PROTECTION OF THE ENVIRONMENT. Bovard, P. (CEN, Fontenay-aux-Roses, France). Agriculture (Paris); No. 366, 162-164 (Jun 1973). (In French).

The compatibility of economic considerations and the safeguard of the environment is discussed. The effects on the environment of wastes from nuclear installations were studied: transfer of pollutants across the different chains in the environment and the effects of the pollutants on the equilibrium of ecosystems. Knowledge about the initial conditions is very important. Monitoring and control equipment is necessary. The utilization of the experience acquired in health physics measurements for the study of other types of pollution is discussed. (FR)

Radiometric Techniques

Refer also to abstracts 7505, 7707, 7708, 7744, 7800, and 8475.

7722 (BNL-18329) POTENTIAL APPLICATIONS OF ISOTOPES IN POLLUTION CONTROL. Fowler, E. E.; Tucker, W. D. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 22p. (CONF-731116-2). Dep. NTIS $3.25.

From eleventh conference on radioisotopes; Tokyo, Japan (13 Nov 1973).

A review is presented of the applications of nuclear techniques to studies on pollution control. The determination of trace-level

constituents in atmospheric particulates, in water samples, and in biological materials by neutron activation analysis is reviewed with emphasis on the use of ^{252}Cf as a neutron source. A discussion of the use of tracers in pollution studies includes the use of ^{85}Kr and ^{35}S for determining the behavior of moving air masses; the use of ^{82}Br for water pollution tracing; determination of the fate of SO_2 in plumes emitted from stacks of fossil fuel power plants using the ratio of ^{32}S to ^{34}S; and use of the ratio of ^{14}N to ^{15}N to follow the behavior of nitrogen oxides emitted from stationary sources. The measurement of physical properties of suspended sediments and sludge densities using radioisotopes is discussed. A review of radiation treatment of sewage and waste water includes: the use of isotopic gamma and accelerator electron sources for processing liquid waste; effects of radiation on sedimentation rate and colloidal properties of solids in waste waters; combined use of gamma radiation and biological methods for purifying sewage; and programs and activities recommended for consideration by IAEA. (HLW)

7723 (EURISOTOP-78) RADIOMETRIC AGE DETERMINATION AND THE USE OF STABLE ISOTOPES IN GEOLOGICAL RESEARCH. Stahl, W.; Schoell, M.; Wendt, I. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). Oct 1973. 192p. (In German). Dep. NTIS (U. S. Sales Only) $11.75.

From the standpoint of geological dating, the following radiometric methods are covered: rubidium–strontium; potassium–argon; uranium–thorium–lead; and lead–lead. Practical application is illustrated on granite intrusions of several mountain ranges of Europe. Also treated are stable isotopes of carbon, oxygen, and sulfur. Examples for their practical application include the origin of natural gas and the study of hydrothermal deposits. (HBG)

7724 REPORT OF THE WORKING PARTY. pp 28-33 of Research in the Geological Sciences. London; Natural Environment Research Council (1973).

The working party on geochronology and isotope geology presented a report under the following heads: geochronology and geochemistry of radiogenic isotopes, geochemistry of non-radiogenic isotopes (stable isotopes), geochronology using short-lived radioisotopes, radiocarbon dating, other techniques of geochronology and isotope geology, isotope geochemistry of meteorites and extraterrestrial material (including lunar rocks). The conclusions were: research into geochronology and isotope geology should advance on a broad front; research in the geochemistry of stable isotopes should be strongly encouraged; geochronology using short-lived radioisotopes should await clearer evidence of the viability of the methods before any large project is initiated; facilities for radiocarbon dating in the UK are adequate; research into novel methods of dating should continue to be supported, on a small scale; a modest expansion of effort in the geochemistry of meteorites and other extra-terrestrial material is desirable; a comprehensive review of facilities is necessary by 1975; a comparative study of available mass spectrometers would be extremely useful; on-line computing facilities for solid-source mass spectrometers are desirable. (UK)

7725 SNOW-WATER EQUIVALENT MEASUREMENT USING NATURAL GAMMA EMISSION. Grasty, R. L. (Geological Survey of Canada, Ottawa). Nord. Hydrol.; 4: No. 1, 1-16(1973).

The natural gamma radiation emitted by potassium, uranium, and thorium is attenuated by snow. This attenuation depends on the water-equivalent of the snow layer. Air absorption coefficients were determined by flying at different altitudes over a uniform test strip and used to calculate the absorption coefficients for water. Results using the Geological Survey of Canada high sensitivity airborne gamma spectrometer showed that snow water-equivalents up to 18 cm could be measured to an accuracy of 2 cm over suitable terrain. The importance of temperature and soil moisture corrections are discussed, together with statistical, instrumental and navigational errors. (CA)

7726 ALGORITHM OF GAMMA-RADIATION COMPUTATION IN RUM PROGRAMS. Shlykov, V. S. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 21-30 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The development and testing of the algorithm of the calculation of the intensity of the γ radiation for NGK, NA, and INGK methods was examined. The algorithm was developed in the form of one of the blocks of the appropriate RUM program. The approximation of the accumulation factor of the γ radiation for multilayer media of complex chemical composition was described. The results of the testing of the algorithm agree satisfactorily with the algorithm of calculations by the Monte Carlo method. (tr-auth)

7727 SENSITIVITY OF MANY-SPACED NEUTRON LOGGING TO VARIATIONS IN HYDROGEN CONTENTS DEPENDING ON THE FAST NEUTRON SOURCE SPECTRUM. Shlykov, V. S. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 54-59 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The effect of the fast neutron source spectrum on the sensitivity of the many-spaced neutron logging to variations of the hydrogen content was examined using as an example the comparison of the many-spaced neutron logging with the Cf and Po–Be sources in the range of probe length of 30 to 60 cm. It was shown that in the porosity interval from 5 to 30% the sensitivity with Cf sources is 35% higher than with Po–Be. (tr-auth)

7728 POSSIBILITY OF USING DUAL-PROBE MODIFICATION OF PULSE NEUTRON–NEUTRON LOGGING FOR DISMEMBERING GEOLOGICAL BORE SECTIONS ACCORDING TO HYDROGEN CONTENTS. Yudin, V. A.; Lutfirakhmanova, L. B.; Tseitlin, V. G. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 14-20 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

Modifications of the pulse neutron-neutron logging were examined. In the modification the ratio of the density of the thermal neutrons registered during one delay period by two detectors placed at different distances from the source. The reading of such a method makes it possible to determine quantitatively the hydrogen content of powerful homogeneous strata. Sources and errors of the determination of the hydrogen content were investigated. The optimum conditions for the measurement were found. A comparison was made with the data from the Monte Carlo method of model and bore measurements. (tr-auth)

7729 USE OF GAMMA-RADIATION SPECTROMETRY, FAST NEUTRON INELASTIC SCATTERING FOR ALUMOSILICATE PROSPECTING. Andreev, V. K.; Barenbaum, A. A.; Egiazarov, B. G.; Sel'dyakov, Yu. P.; Yakubson, K. I. pp 95-105 of Yadernoe Priborostroenie. Moscow; Atomizdat (1972). (In Russian).

The results of the determination of the ratio of Al and Si (Si model) of large-mass alumosilicate rocks by means of γ spectrometry, accompanied by the inelastic scattering of neutron with energy of 14 Mev were reported. The experiments made on models imitating hole measurement conditions indicated the future use of methods using γ radiation and neutron scattering for the determination of the silicon model under conditions of the natural occurrence of rocks. The γ radiation and neutron scattering method in comparison with the two-source method used for this purpose has a series of advantages such as, for example, the very high precision of the determination of the silicon model, low dependence on the hydrogen content, practical independence on the Fe content. (tr-auth)

7730 USING GAMMA-LOGGING TECHNIQUES FOR DETERMINING THE NATURE OF RESERVOIR BED SATURATION UNDER CONDITIONS OF HIGHER GAMMA ACTIVITY. Vasil'ev, S. I. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 64-69 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The results of the simulated and boring experiments, indicating the possibility of the determination by the γ logging of the saturation of the productive strata, expressed by increased γ activity, were reported. (tr-auth)

7731 PROCEDURE AND APPARATUS FOR RADIOACTIVITY WELL LOGGING. Hall, H. E. Jr.; McKay, A. S.; Paap, H. J. (to Texaco Development Corp.). Danish Patent 989/72. 4 Dec 1972. Filed date 3 Mar 1972. 27p. (In Danish).

An apparatus for conducting radioactive well logging comprising an instrument suitable for introduction through a borehole going through a number of earth formations is described. The instrument contains a fast-neutron source for irradiation of the earth formations round the borehole and a radiation in the borehole coming from the radiation source. The detector contains a proportionally working gamma radiation indicator with a multi-channel pulse height analyzer for providing output signals in at least two energy intervals, one corresponding to gamma radiation with an energy from 1.3 MeV to approx. 3.0 MeV, the other corresponding to an energy from approx. 4 MeV and upwards to comprise at least the prevalent neutron capture gamma radiation with higher energy coming from chlorine. Further the instrument contains a shield essentially surrounding the active volume of the radiation detector in the scanning instrument. The shield has a comparatively high

thermal neutron capture cross section and a characteristic neutron capture gamma radiation emission mainly within the energy interval of the first channel. The signal obtained from that channel includes a formation reference signal mainly indicating hydrogen, and the signal from the second channel a formation reference and chlorine signal mainly indicating both hydrogen and chlorine. (HV)

7732 EXPERIMENTAL STUDY ON CONNECTION BETWEEN THE PULSE GAMMA–GAMMA LOGGING READINGS, ORE DENSITY, AND BOREHOLE PARAMETERS. Krasil'nikov, B. N. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 99-104 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The results of experimental work carried out under laboratory conditions on models of strata were reported. It was shown that the decrement of attenuation of the scattered γ quanta is tightly connected with the density of the rocks and in a given time interval does not depend on the logging parameters. The magnitudes of the effective lifetime of the γ quanta in media with density of 1, 1.7, 2.2, and 2.7 g/cm^3, obtained by experimental and calculation methods, were given. The processing of experimental and calculation curves and the agreement between them was shown. (tr-auth)

7733 EFFECT OF BOREHOLE DESIGN AND FILLING ON PULSE NEUTRON–NEUTRON LOGGING READINGS AND SOLVING THE PROBLEM OF CASED HOLE HOMOGENIZING. Tseitlin, V. G. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 46-53 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The effect of each layer of construction of the hole (fluid in the column, the column, cement) and of the depth of the instrument on the process on the determination and the form of the radial neutron scattering during pulse neutron–neutron logging was examined. The possibility of the substitution of complex multilayer holes with equivalent homogeneous holes was indicated. The error in the amplitude of the response rose no more than 20% and in the decrement of the time attenuation no more than 3 to 4% during time delay greater than 1 msec. The dependence of the decrement of the time attenuation on the absorbing and scattering properties of the hole medium was investigated in detail. (tr-auth)

7734 RADIOISOTOPE QUALIFICATION OF COAL SAMPLES. Endre, T. pp 221-235 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

Investigations are described on the scope of the radioisotope technique for the determination of ash content and its adaptation for industrial purposes. Details are presented of the ash-content analysers designed at the Institute to meet the special local requirements of Hungarian industry. (auth)

Site Surveys

7735 (AECL-4511) AQUATIC VEGETATION OF THE OTTAWA RIVER NEAR CHALK RIVER NUCLEAR LABORATORIES (CRNL). Gentner, S. R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). May 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25. AECL $0.50.

In the summer of 1972 a preliminary survey of the aquatic vegetation in the Ottawa River near the Chalk River Nuclear Laboratories from the Pump House downstream to Pte. au Baptême on the Ontario side was undertaken. Maps showing the distribution of the vegetation along the shoreline and in the water were drawn up, and a checklist of all the vascular plants found was compiled. (auth)

7736 (HW-57309) MAGNETIC METHOD OF GEOPHYSICAL EXPLORATION ON THE HANFORD PROJECT: INTERIM REPORT. Raymond, J. R. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 2 Sep 1958. Contract W-31-109-Eng-52. 23p. Dep. NTIS $3.25.

A Sharpe model A-2 vertical force magnetometer was used for aerial monitoring to determine the practicability of the magnetic geophysical method for defining basalt bedrock depth and configuration on the Hanford project. Ten magnetic survey lines were run across and generally at right angles to the strike of known geologic structures. The method proved successful in detecting and tracing buried basalt ridges and valleys and is fast, relatively simple, and inexpensive. Determining precise location of the ridges is straightforward since the magnetic highs appear almost directly above the highest elevation of the buried ridges, as nearly as can be determined. Quantitative evaluation as to depth to the responding formation may be quite complex and will probably require assistance from an expert in the field of magnetic geophysical methods. Even with the few lines run and the preliminary nature of the data, several significant observations were made. Gable Mountain-Gable Butte are not extensions of the existing Umtanum Ridge as was previously thought, but are separate folds. There is some suggestion that the Gable Buttes are separate from Gable Mountain and from each other. These structures also seem to rise above or close to the surface of the ground-water table over most of their extent on the project. The buried extension of the Yakima Range appears to be a complex of at least two separate ridges (topographically at least). Magnetic surveys would provide valuable support data for use with seismic exploration, but certainly not supplant such seismic studies. Magnetic exploration may be thought of as a reconnaissance method and will give much valuable information on basalt structure for very small expenditures of time and money. (auth)

7737 (HW-67807) WELL AND AQUIFER EVALUATION TEST IN 200-E AREA. Raymond, J. R.; McGhan, V. L. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 19 Dec 1960. Contract AT(45-1)-1350. 16p. Dep. NTIS $3.00.

A well to provide an emergency source of condenser cooling water was drilled in the 200 East Area north of the 241-A tank farm at plant coordinates N-42370, W-47350. A flow of 100 gpm was specified. The criteria for site selection, the pumping tests, and the pumping test results are discussed. (CH)

7738 (HW-76181) CHEMICAL AND PHYSICAL PROPERTIES OF 100 AREA SOILS. Bensen, D. W.; Nelson, J. L.; Alkire, G. J. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 10 Oct 1963. Contract AT(45-1)-1350. 43p. Dep. NTIS $4.25.

Physical and chemical properties of Hanford 100 Area soils were determined to characterize the soil and to provide data for use in selection of sites that might be best suited for disposal of reactor wastes. A summary is presented of the cation exchange capacities and the particle size distribution of samples of subsoil taken from wells in and near the 100 Areas. (auth)

7739 (HW-78924) RESULTS OF AN AIRBORNE MAGNETOMETER SURVEY OF THE HANFORD PROJECT. Raymond, J. R.; McGhan, V. L. (General Electric Co., Richland, Wash. (USA). Hanford Atomic Products Operation). 12 Sep 1963. Contract AT(45-1)-1350. 22p. Dep. NTIS $3.25.

Data obtained from the aeromagnetic survey of the Hanford Project were reduced, compiled, and plotted to obtain a map showing contours of equal magnetic intensity. General configuration of the basalt bedrock was evident due to the high magnetic susceptibility of the basalt. The low susceptibility of the overlying sedimentary material caused little or no distortion of the earth's magnetic field; thus the presence of buried bedrock structures was easily determined. The survey was of a reconnaissance nature, and quantitative evaluation was not practical. Several basalt ridges delineated were in whole or part detected by the Hanford well system; other structures, missed by the well network, were detected geomagnetically. The aeromagnetic data should be helpful in evaluating the structure of the basalt bedrock which forms the lower boundary of the ground-water flow system. Normally, airborne magnetometer surveys are flown at a near constant altitude above mean sea level; however, because this survey was secondary to the primary radiometric investigation, the flights were made at near constant altitudes above ground surface. This presented complications in data interpretation which, theoretically at least, were resolvable by correcting the magnetic data to a single altitude datum plane. This was done, but the resulting correlations (known basalt elevations vs. magnetic readings) were no better, and in some cases worse, than those based on variable altitudes. In this particular case, the effects on the recorded data attributable to the complex geometry of the basalt were apparently of appreciable or greater influence than those effects due to altitude changes. (auth)

7740 (IDO-12078) NATIONAL REACTOR TESTING STATION ENVIRONMENTALLY RELATED PUBLICATIONS. Markham, O. D. (USAEC Idaho Operations Office, Idaho Falls. Health Services Lab.). Nov 1973. 12p. Dep. NTIS $3.00.

The 95 references were compiled while reviewing the literature on environmental studies at the National Reactor Testing Station. The list, arranged by first author, has been restricted to publications resulting from work in the area since the establishment of the site. Progress reports, safety review documents, and other similar papers have been excluded. (auth)

Thermal Effluents

Refer also to abstracts 9346 and 9504.

7741 POLLUTIONS MARINES ET AMENAGEMENT DES RIVAGES. (Marine Pollution and Management of Shores). Aubert, M.; Aubert, J. Nice; Centre d'Etudes et de Recherches de Biologie et d'Oceanographie Medicale (1973). 310p.

The fourteen chapters of the book are presented in three sections entitled description of marine pollution, oceanographic techniques in marine pollution studies, and prevention of marine pollution and management of shores. The first section discusses thermal, bacterial, radioactive, chemical and organic pollution. In the chapter on thermal pollution, emphasis is placed on the effects of heated effluents on the ecological balance of estuaries. Effects of waste products from nuclear industries are discussed in the chapter on radioactive pollution as well as the development of fission products, radioactive wastes from nuclear-propulsion ships, wastes from nuclear accidents, and wastes from atomic bomb explosions. Measures for prevention of pollution include management of stream mouths and studies on pollution of parts and artificial beaches. (approximately 200 references) (HLW)

7742 THERMAL LOAD AND HEAT REMOVAL CAPACITY OF A RIVER. Zimmermann, C.; Kobus, H. (Univ., Karlsruhe, Ger.). Energie; 25: No. 7-8, 225-231(1973). (In German).

The decision of whether the exclusive use of fresh water cooling for a power plant is possible requires a deeper investigation into the course of river temperatures, of draining, and of the extreme values of both of these over a long period of time. The behavior of the past years in the German rivers seems however to justify the very unfavorable assumption of coincidence of high temperatures and an extremely low water period. In addition, the worsening of the river water quality makes the decision to use cooling towers, which provisionally can substantiate the oxygen balance in the river seem advisable. By means of a heat removal plan, it is possible to decide when it becomes uneconomical for a power plant to have fresh water cooling and closed circuit cooling at the same time. The predictions depend on the knowledge of heat exchange processes on the water's surface and on the hydraulic behavior of the led-in cooling water. As example, the heat removal capacity of the Rhine is given using the calculated fundamentals of the heat conduction plan. (GE)

Chemical Effluents

Refer also to abstracts 9543, 9677, and 9694–9696.

7743 (AECL-4605) PROPOSED AUTOMATED SPECIFIC ION ELECTRODE SYSTEM FOR MEASURING TRACE SULFIDE CONCENTRATIONS IN AQUEOUS SOLUTION. Phillips, D.; Mislan, J. P. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

Restrictions have been placed on the concentration of sulfide in effluent water discharged from G.S. heavy water production plants. A simple, sensitive specific ion electrode system for monitoring sulfide ion in the 20 to 100 ppB concentration range was assembled and tested. The apparatus and methodology are described. (auth)

7744 (CEA-R-4505) ROLE OF THE ORGANIC MATERIALS OF A WATERWAY WITH RESPECT TO RADIOACTIVE POLLUTION. Organic Substances in Solution in the Water. The Influence of the Concentration Ratio on Fractionation. Water-Sediment Relationships. Faure, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. de Protection). Oct 1973. 42p. (In French). Dep. NTIS (U. S. Sales Only) $4.25.

Contaminants of water of the Rhône River were studied by the precipitation of mineral and organic substances, by means of nuclear measurements, absorption and emission spectroscopy, conductivity, and potential measurements. Gel chromatography and ultra-filtration methods revealed the effect of water concentration on the molecular distribution of organic substances dissolved in the water; they permit, by extrapolation, the determination of the actual molecular distribution of organic substances in unconcentrated natural water. Comparison of the results of this study of water with those previously obtained for sediments leads to the conclusion that the organic substances in the water are similar to those in sediments. This in turn implies a chemical balance between water and sediment. (auth)

INSTRUMENTATION

Refer also to abstract 9518.

Radiation Detection Instruments

General Detectors and Monitors

Refer also to abstracts 7495, 7711, 8105, 8115, 8124, 8431, 8438, 8462, 9387, and 9391.

7745 (ANL/NDM-2) PROMPT AIR-SCATTERING CORRECTIONS FOR A FAST-NEUTRON FISSION DETECTOR: $E_n \leq 5$ MeV. Smith, D. L. (Argonne National Lab., Ill. (USA)). Sep 1973. Contract W-31-109-eng-38. 83p. Dep. NTIS $6.25.

Neutrons which have scattered many times in surrounding air and in laboratory objects arrive randomly in time at a detector and can be discriminated by time-of-flight techniques. Neutrons which have scattered only a few times in air reach the detector soon after the primary neutron burst and cannot be distinguished from the latter by time conditions. Most of the prompt air-scattered neutrons have undergone only one elastic collision and it has been shown that the ratio of these singly-scattered to primary neutrons increases linearly with distance from a point source. The energy, time and angular distributions of neutrons which scatter once in surrounding air before reaching a fission detector have been calculated for E_n = 0.05 to 5 MeV using published cross sections. Data corrections for prompt air-scattered neutrons are generally small but not necessarily negligible in high-precision measurements. For example, it has been calculated that this effect leads to a correction of ~0.2 to 0.3% in a measurement at E_n = 1.5 MeV of the ^{238}U to ^{235}U fission cross section ratio if the back-to-back uranium deposits in a double fission detector are situated 10 cm from the neutron source. This correction is significant since ≲ 1% accuracy is currently sought in fission cross section ratio measurements. (auth)

7746 (N-73-29442) DIRECTIONAL LOW-ENERGY GAMMA-RAY DETECTOR. Morfill, G.; Pieper, G. F. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sep 1973. 30p. (NASA-TM-X-70449). NTIS $3.50.

The sensitivity of a directional gamma ray detector, which relies on blocking a source to determine its direction and energy spectrum, is calculated and compared to the more conventional well-shaped shielded detectors. It is shown that such an anticollimator detection system provides a basis for measuring the celestial diffuse gamma ray background, gamma ray sources and bursts with good energy, angular, and time resolution, and that additionally the system is 20 to 50 times as sensitive as conventional detectors when compared on a per unit mass basis. (auth)

7747 (ORNL-TM-4317) DESCRIPTION OF FACILITY RADIATION AND CONTAMINATION ALARM SYSTEMS INSTALLED IN THE INTERMEDIATE AND HIGH LEVEL WASTE EVAPORATOR BUILDING (BLDG. 2531). Hall, C. C. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 20p. Dep. NTIS $3.00.

A Facility Radiation and Contamination Monitoring System was installed in the Intermediate and High Level Waste Evaporator Building, Building 2531, to continuously monitor airborne beta-gamma contamination, beta-gamma background radiation, and steam condensate beta-gamma and gamma radiation. The monitoring instruments and their associated system components provide health physics information, sound local alarms when abnormal conditions occur, and indicate the abnormal condition on a central panel in the operating area. Beta-gamma air monitoring instruments actuate the building containment system when a predetermined level of airborne contamination is reached or when any one of the air monitors becomes inoperative. (auth)

7748 (SLA-73-5985) EFFICIENCY VERSUS FREON CONTENT FOR A MULTIWIRE PROPORTIONAL COUNTER HAVING 3 mm ANODE WIRE SPACING. Dieterle, B.; Heaphy, R.; Johnson, M. K. (New Mexico Univ., Albuquerque (USA)). 1973. Contract 51-6428. 9p. Dep. NTIS $3.00.

For Sandia Labs.

The efficiency of a multiwire proportional counter filled with argon, isobutane and freon 13B1 is found to depend only on freon concentration, and exceeds 99% for ≲ 0.3% freon. (auth)

7749 (UCRL-74797) DUAL ENERGY ANALYSIS USING PHOSWICH SCINTILLATION DETECTORS FOR LOW-LEVEL IN-VIVO COUNTING. Shapiro, E. G.; Anderson, A. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Oct 1973. 11p. (CONF-731112-12). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

Electronics developed for a whole body counting system analyze the pulse heights of signals from both the sodium iodide (NaI(Tl)) and cesium iodide (CsI(Na)) crystals of a phoswich scintillation detector. Pulse shape discrimination is used to determine the origin of the scintillation, NaI or CsI, while rejecting coincident Compton-scattered events and photomultiplier tube noise. Both energy spectra are accumulated simultaneously in separate memory quadrants of a multichannel analyzer. The system allows for low-energy (5 keV to 125 keV) x-ray analysis from the NaI(Tl) crystal and high-energy (100 keV to 2.5 MeV) x-ray or γ-ray analysis from the CsI(Na) crystal. The discrimination system is better than 95% efficient over both energy ranges, with a low-energy (12-24 keV) shielded background count of less than 2 cpm for a single 5-in.-diam phoswich detector. This system thus extends the detector's normal energy range by more than an order of magnitude. (auth)

7750 MOVABLE PROBE DEVICE FOR DETECTING RADIATIONS. Volat, J. P. (to Commissariat a l'Energie Atomique). French Patent 2,143,584. 30 Jun 1971. 6p. (In French).

A movable probe device for detecting radiations is presented. It consists of a pulse detector housed in a movable probe providing electric pulses as a function of the intensity of the radiation detected together with equipment for measuring the pulses, this equipment being positioned away from the probe. The probe is connected to the electronic equipment by a cable in the form of an insulated conductor which supplies the probe with a small dc current from a low tension power supply. The device is provided with means for converting the current at low tension into a dc current at high tension for the detector, means for increasing the intensity of the pulses provided by the detector and for transmitting them by the conductor into the measurement equipment, and means for bypassing these pulses in relation to the converter and detector. (FR)

7751 MOVABLE PROBE DETECTION DEVICE. Palumbo, C.; Volat, J. P. (to Commissariat a l'Energie Atomique). French Patent 2,144,087. 30 Jun 1971. 7p. (In French).

A movable probe detection device intended principally for measuring radiations, is described. The movable probe is provided with a detector, which emits information in the form of a variable dc or pulsed current, a self-supplying electrical power supply, and an oscillator producing a high frequency ac current modulated as a function of the information emitted. Means are also provided for inductively coupling the oscillator and the conducting cable in order to transfer the modulated signal to the cable and through the cable up to signal receiving and processing equipment outside of the probe. (FR)

7752 RADIOACTIVE HALOGEN MONITORING SYSTEM. Lee, J. S.; Alves, W. R. (to General Electric Co.). US Patent 3,769,505. 30 Oct 1973. Filed Date 15 Mar 1972. 6p.

A system of two or more filter-detectors for detecting radioactive halogens such as iodine in a gas stream also containing other radioactive substances such as radioactive noble gases, is described. The system is particularly designed for monitoring iodine in reactor off-gas streams. (Official Gazette)

7753 AUTOMATIC DOT FACTOR SYSTEM FOR A SCINTILLATION DEVICE AND METHOD OF OPERATION. Brunnett, C. J.; Ioannou, B. N. (to Picker Corp.). US Patent 3,769,508. 30 Oct 1973. Filed Date 23 Jun 1972. 16p.

A scintillation scanner having a dot factor system for automatically spacing the dots which are printed by a color printer representative of radiation activity is described. The dot factor system utilizes circuitry for counting the number of signals which occur at a calibration point or "hot spot" for a predetermined number of intervals of time and then dividing the number of counted signals by the number of intervals of time to develop a calibrate signal having a high degree of statistical accuracy. The calibrate signal is then applied to a decoding and divider network for dividing the number of counts representative of radiation activity by a factor which is dependent upon the number of counts which occur at the calibration point to thereby provide optimum spacing between the printed dots for a given study. (Official Gazette)

7754 SCINTILLATION CAMERA. Martone, R. J.; Mueller, P. G.; Flis, R. J. (to Picker Corp.). US Patent 3,769,509. 30 Oct 1973. Filed Date 15 Mar 1971. 10p.

A gamma imaging camera with a scintillation crystal and a plurality of phototubes is described. A light pipe optically couples the crystal and the tubes. The light pipe has, at its output end, a plurality of truncated pyramids each associated with one of the phototubes. As disclosed, the walls of the pyramids are hexagonal in cross-sectional configuration and flare outwardly to intersect adjacent walls, thus providing a continuous field of view. The disclosure also shows a lift-out detector head subassembly construction. (Official Gazette)

7755 EFFECTS OF GAS MIXTURE, ELECTRODE SPACING, GAS PRESSURE, AND APPLIED VOLTAGE ON THE GAMMA PERFORMANCE OF FISSION COUNTERS. Philipp, L. D. (Hanford Engineering Development Lab., Richland, WA); Hoitink, N. C.; Spear, W. G.; Wood, M. R. Nucl. Technol.; 20: No. 1, 51-59(Oct 1973).

Electron drift velocity, a function of gas composition, electric field, and pressure, represents the most important design parameter for optimization of fission-counter collection time. References in the literature provide a significant source of information on drift velocities for various gases, but the information does not extend to sufficiently high electric field/pressure (E/p) ratios for use with the high-sensitivity fission counters under consideration. The data obtained for this investigation and reported extend the drift-velocity data for argon–nitrogen mixtures to E/p regions useful for present design considerations, and at the same time compare detector performance in a high gamma field (10^6 R/h) with the various gas mixtures employed. Six combinations of argon–nitrogen ranging from 1 to 15% nitrogen were included in the tests. Although several other gas mixtures, such as argon–methane and argon–CO_2, provide faster drift velocities, only argon–nitrogen has proven stable at the high neutron exposure levels anticipated for the Fast Flux Test Facility (10^{18} n/cm^2). Performance comparisons show that for 800-Vdc operation the neutron counting sensitivity for Ar–10% N_2 exceeds that for Ar–1% N_2 (the fill gas most commonly used) by over a factor of 2. Corresponding collection times decreased from 160 nsec for the Ar–1% N_2 mixture to 80 nsec for the Ar–10% N_2 combination. For specific applications, it may be required to limit the voltage to < 800 Vdc. The curves provide information to permit selection of the best gas mixture for a given bias voltage requirement. (auth)

7756 SENSITIVITY SCINTILLATION CRYSTAL AND METHOD THEREFOR. Taylor, A. (to Westinghouse Electric Corp.). US Patent 3,764,810. 9 Oct 1973. Filed Date 22 Dec 1970. 4p.

A method of increasing the sensitivity of a scintillation crystal and improved sensitivity crystal to uranium K radiation wherein thorium, for example, is added to the scintillation crystal to increase the scintillation yield thereof by producing thorium characteristic radiation and increasing production of photoelectrons in response to the absorption of a portion of the uranium K radiation applied thereto is described. (auth)

7757 NEUTRON DETECTOR SYSTEM. Neissel, J. P. (to General Electric Co.). US Patent 3,760,183. 18 Sep 1973. Filed date 8 Jun 1972. 12p.

A neutron detector unit and system comprising an ion chamber and self-powered portions wherein signals from the ion chamber and self-powered portions are compared and the calibration of the ion chamber portion adjusted accordingly is described. (26 Claims, 6 Drawing Figures) (Official Gazette)

7758 IMPROVED GERMANIUM GAMMA DETECTORS HAVING NON-IDEAL CONTACTS AND DEEP LEVEL INDUCING IMPURITIES THEREIN. Hall, R. N. (to General Electric Co.). US Patent 3,761,711. 25 Sep 1973. Filed date 25 Feb 1972. 8p.

An improved Ge gamma detector utilizing a nonideal N+ or P+ electrode to provide restricted leakage current and doping with deep level donor or acceptor-inducing impurities to provide apparent near-intrinsic characteristic and maintain wide depletion regions therein is described. (10 Claims, 1 Drawing Figure) (Official Gazette)

7759 MODIFICATION OF A QUADRUPOLE MASS FILTER TO ACCEPT A CHANNEL ELECTRON MULTIPLIER. McMillan, M. R.; Coplan, M. A. (Univ. of Maryland, College Park). Rev. Sci. Instrum.; 44: No. 8, 1137-1138(Aug 1973).

A commercial quadrupole mass filter has been modified to accept a channel electron multiplier. The modification is relatively simple and inexpensive. The resulting mass filter is very sensitive (gain > 10^7) and compact. (auth)

7760 SIMPLE FLOATING PREAMPLIFIER FOR ELECTRON MULTIPLIERS. Christman, S. B. (Bell Telephone Labs., Murray Hill, NJ). Rev. Sci. Instrum.; 44: No. 8, 1132(Aug 1973).

A simple preamplifier is described which allows one to simultaneously measure ac and dc signals from electron multipliers operating several thousand volts above ground potential. (auth)

7761 X-RAY FILTER FOR PROPORTIONAL COUNTER. Horstman, H. M.; Ventura, G.; Vespignani, G. R. (TESRE–CNR, Bologna). Nucl. Instrum. Methods; 112: No. 3, 567-569(1973).

A combination filter and proportional counter is described, whereby energy bands may be defined using the K-edges of the normal counter fill gases. It should find particular applications in the field of X-ray astronomy with gases such as argon or neon. (auth)

7762 FIELD CORRECTOR FOR PROPORTIONAL COUNTERS. Horstman, H. M.; Ventura, G.; Vespignani, G. R. (TESRE-CNR, Bologna). Nucl. Instrum. Methods; 112: No. 3, 619-620 (1973).

A system for correcting the end field of a proportional counter is described. It consists of concentric rings etched on nonconductive end plates and set at suitable potentials. (auth)

7763 PHOTOMETER FOR PROFILE MEASUREMENTS AND CHARGE IDENTIFICATION ON SHORT TRACKS OF HEAVY NUCLEI STOPPING IN NUCLEAR EMULSION. Jacobsson, L.; Joensson, G.; Soderstroem, K.; Hakansson, H. (Univ. of Lund, Sweden). Nucl. Instrum. Methods; 112: No. 3, 575-580(1973).

The technical construction of a nuclear-track photometer which can be used for a detailed study of track structure and for the determination of the charge of low-energy, heavy particles is discussed. The essential parts of the photometer are a narrow slit and a revolving mirror system which moves the image of a track segment across the slit. The absorption profile, which is obtained in this passage, is registered either with a pen recorder or in digitalized form on paper tape. Different width parameters are discussed with regard to charge resolution. (auth)

7764 THIN dE/dx DETECTORS OF UNIFORM THICKNESS MADE ON EPITAXIAL SILICON. Ponpon, J. P. (Univ. Louis Pasteur, Strasbourg); Siffert, P.; Vazeille, F. Nucl. Instrum. Methods; 112: No. 3, 465-467(1973).

Anodic dissolution of the low resistivity N^+ silicon substrate has been used to prepare dE/dx nuclear particle detectors on the remaining epitaxially grown high resistivity N film. Robust fully depleted counters with sensitive layers thinner than 5 μm, with good uniformity can be made by this technique. Their characteristics are discussed. (auth)

7765 COOLING SILICON SURFACE-BARRIER PARTICLE DETECTORS. Calligaris, F.; Ciuti, P.; Gabrielli, I.; Giacomich, R. (Univ. degli Studi, Trieste, Italy). Nucl. Instrum. Methods; 112: No. 3, 591-595(1973).

The energy resolution of a surface-barrier detector, thermoelectrically cooled, has been measured from 20°C to –30°C. Different thermic screens have been used in order to evidence the effect of thermic gradients inside the detector. (auth)

7766 PROPORTIONAL CHAMBERS WITH 1 mm WIRE SPACING. Price, L. E. (Columbia Univ., New York). Nucl. Instrum. Methods; 112: No. 3, 507-511(1973).

Moderate-size proportional chambers (30 cm square) have been built with 1 mm wire spacing. The chambers operate stably with very low background noise. Full efficiency is seen with a plateau more than 1 kV wide. Construction and operating characteristics are described. (auth)

7767 PULSE-SHAPE DISCRIMINATION IN THE PROPORTIONAL COUNTING OF TRITIUM BETAS. Sudar, S.; Vas, L; Biro, T. (Kossuth Univ., Debrecen, Hungary). Nucl. Instrum. Methods; 112: No. 3, 399-404(1973).

The advantages of pulse shape discrimination used for the reduction of background in the proportional counting of tritium betas are discussed. Experimental results obtained by both meson anticoincidence and PSD are compared. In the 3 to 15 keV energy range the background was reduced 15-fold to a significantly lower level than with meson anticoincidence, while the tritium counting efficiency was reduced by only 10%. (auth)

7768 DETERMINATION OF NATURAL RADIOACTIVITY IN RARE EARTH MATERIALS. Grench, H. A.; Buchanan, R. A. (Lockheed Palo Alto Research Lab., Palo Alto, CA). Nucl. Instrum. Methods; 112: No. 3, 415-421(1973).

The intrinsic and contaminant γ-ray activity of samples of the rare earth materials Y_2O_2S, Gd_2O_2S:Tb, La_2O_2S:Eu and La_2O_3 has been studied. These materials are of interest as high Z scintillators and phosphors for X-ray and γ-ray detection; therefore, their background levels of activity may be critical. Both NaI(Tl) and Ge(Li) detectors were used for the detection of γ-ray emis-

sion from these samples. The methodology and value of using a Ge(Li) detector in the identification of low-level natural radioactivity are illustrated. A comparison is made with results using a NaI(Tl) detector. Although the first two materials above exhibited no γ-ray activity, the latter two showed many γ-ray peaks in addition to those due to naturally radioactive ^{138}La. The contaminant peaks have been identified as arising from members of the decay chain of ^{238}U. Both the Y_2O_2S and Gd_2O_2S appear to be promising host crystal materials; La_2O_2S and La_2O_3 need to be even more highly purified to be of use in many applications. (auth)

7769 RADIATIVE ENERGY TRANSFER OF LIQUID SCINTILLATION. Ishikawa, H. (Japan Atomic Energy Research Inst., Tokyo); Takiue, M. Nucl. Instrum. Methods; 112: No. 3, 431-435 (1973).

A radiative energy transfer accounting for the luminescent mechanism of liquid scintillation has been measured with the aid of special measuring geometry. The radiative energy transfer with respect to toluene, benzene, xylene and anisole was observed, utilizing ^{14}C and 2,5-diphenyloxazole, from view-points of spectral analysis, quantum yield and electric pulse-height distribution. (auth)

7770 LIQUID SCINTILLATION MEASUREMENT FOR β-RAY EMITTERS FOLLOWED BY γ RAYS. Ishikawa, H. (Japan Atomic Energy Research Inst., Tokyo); Takiue, M. Nucl. Instrum. Methods; 112: No. 3, 437-442(1973).

The β-ray emitters which are followed by γ-rays have been measured utilizing a liquid scintillation counter. This instrument enables the nuclides to be accurately measured without any absorption and scattering of radiations under the condition of 4π geometry. The radioactivities of ^{46}Sc, ^{59}Fe, ^{60}Co and ^{86}Rb were determined with the aid of a channel ratio method and an external standard method. The results obtained agree considerably well with the values found by γ-ray spectrometry. (auth)

7771 POSITION-SENSITIVE SURFACE-BARRIER Si(Li) DETECTOR FOR LOW ENERGY γ RAYS. Biebl, U.; Parkak, F. (Technische Univ., Munich). Nucl. Instrum. Methods; 112: No. 3, 455-461(1973).

A checker-board surface-barrier Si(Li) detector for low energy γ rays is described together with its read-out system. The counter has 64 elements of 2×5 mm^2 each, but requires only 16 electronic circuits for the read out through the use of coincidence techniques. Energy resolution (<2 keV fwhm), counting rate efficiency (>95%) and background (<0.01 cpm/keV/element) for 14.4-keV γ rays are essentially the same for all elements. The response of the counter to radiation falling between two elements has been studied and causes no problems. Such a detector, modified in element geometry for protein structure analysis, shows similar characteristics. (auth)

7772 REDUCTION OF AFTERPULSING IN A PHOTOMULTIPLIER. Hall, S. J.; McKeown, J. (Univ. of Glasgow). Nucl. Instrum. Methods; 112: No. 3, 545-549(1973).

Large pulses in photomultiplier tubes are frequently found to generate smaller pulses approximately 0.5 μs later. Where such large pulses represent some form of background, they can be suppressed in a manner which reduces drastically the number of afterpulses generated. A technique is described for application to 58 AVP/XP1040 photomultipliers, and the effects discussed. (auth)

7773 METHODS OF ABSOLUTE ACTIVITY MEASUREMENT. Istvan, P.; Arpad, V. pp 135-171 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

Topics dealt with include radioactivity units, available counting techniques including fixed angle, $4\pi(\beta + \gamma)$, $4\pi\beta$, Auger electron) gas phase and 4πX overpressure proportional methods; $4\pi\beta$ liquid and plastic scintillation; $4\pi(\beta - \gamma)$, $4\pi(X - \gamma)$, coincidence, coincidence with a single detector; and $X - \gamma$ and $\gamma - \gamma$ fixed angle coincidence. The guidelines to be followed in the choice of the optimum method are discussed. (98 references) (auth)

7774 USE OF A DIFFUSION CLOUD CHAMBER FOR AN EXPERIMENT ON THE ASYMMETRY AT SMALL ANGLES (<10°) IN THE ELASTIC SCATTERING OF 40 MeV POLARIZED PROTONS. Bendiscioli, G.; Gigli Berzolari, A.; Lodi Rizzini, E. (Univ., Pavia, Italy). Nucl. Instrum. Methods; 113: No. 1, 113-118(1973).

The Milan AVF cyclotron was used in an experiment on the asymmetry at small angles (<10°) in the elastic scattering of 39.5 MeV polarized protons on argon nuclei. The experiment has been carried out by means of a diffusion cloud chamber. The experimental set-up and the event reconstruction technique are described, and some limitations relative to the measurement of events with very small projected angles are discussed. (auth)

7775 STUDY OF THE RESPONSE OF SILICON-BARRIER DETECTORS TO PROTONS AND α-PARTICLES. Langley, R. A. (Sandia Labs., Albuquerque, NM). Nucl. Instrum. Methods; 113: No. 1, 109-112(1973).

A study of silicon-barrier detector response was made using beams of protons and α-particles which had been backscattered from a high-Z target. A technique for measuring effective window thickness in terms of an equivalent metal electrode is presented. Also presented is a method for determining the relative energy per electron–hole pair for different incident particles in silicon: using this method, it is found that $\epsilon(\alpha\text{-particles})/\epsilon(\text{protons}) = 0.978 \pm 0.006$. (auth)

7776 ANNEALING OF LATENT DAMAGE TRAILS IN SOLID-STATE NUCLEAR TRACK DETECTORS. Khan, H. A.; Durrani, S. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 113: No. 1, 51-54(1973).

Experiments have been carried out to gain some further insight into the annealing behaviour of latent damage trails in Solid State Nuclear Track Detectors (SSNTDs). The results indicate that on annealing, (a) a latent damage trail shrinks both radially and axially thus causing a decrease in the etchable range and an increase in θ_c, the critical angle of etching, and (b) the decrease in the number density of tracks in the initial stages of the annealing process is mainly due to the disappearance of oblique tracks. (auth)

7777 ANALYSIS OF THE CAUSES OF THE PULSE HEIGHT DEFECT AND ITS MASS DEPENDENCE FOR HEAVY-ION SILICON DETECTORS. Finch, E. C. (Trinity Coll., Dublin). Nucl. Instrum. Methods; 113: No. 1, 41-49(1973).

The mass dependence of the pulse height defect observed with heavy-ion radiation detectors is, like the defect itself, a useful parameter in comparisons of observed detector responses with theoretical predictions. Such a survey is made in which are assessed the contributions of non-ionizing nuclear collision losses and charge carrier recombination losses to the defect and its mass dependence as observed with fission fragments and similar ions incident on silicon surface barrier detectors. In particular recombination effects are evaluated by relating the charge losses, through expressions for the recombination lifetime of the carriers in the plasma formed in the wake of each fragment and the lifetime of the plasma itself, to previously established experimental data for heavy-ion stopping powers in solids. The correlation between hot carrier effects in the decay of the plasma and the relatively small observed field dependences of the defect and its mass variation is emphasized. Agreement can be obtained between the predictions and the rather wide range of experimental results which have been observed if in the recombination theory the silicon minority carrier lifetime is regarded as a variable parameter for which an upper limit can be determined from the resistivity of the detector material. For a lifetime of 10^{-4} s, which can be expected in good detector material of resistivity a few ohm-m, a value typical in heavy-ion detectors, the predictions for the total defect and its mass dependence for fission fragments are about 10 MeV and 0.1 MeV amu^{-1}, respectively. (auth)

7778 MEASUREMENTS OF THE PULSE HEIGHT DEFECT AND ITS MASS DEPENCENCE FOR HEAVY-ION SILICON DETECTORS. Finch, E. C. (Trinity Coll., Dublin); Rodgers, A. L. Nucl. Instrum. Methods; 113: No. 1, 29-40(1973).

The response of different types of gold silicon surface barrier detectors to fission fragments is investigated in terms of the pulse height defect and its dependence upon the energy and mass of the fragments. The experimental results are obtained using a fission fragment time-of-flight spectrometer which is installed within the thermal column of the research reactor HERALD at AWRE Aldermaston. Large values of about 15 MeV for the defect and 0.2 to 0.5 MeV amu^{-1} for the mass dependence are observed. A comparison with the results of other workers is given together with an explanation of how nuclear collision losses and charge recombination losses might account for the observed results. (auth)

7779 BACKGROUND REDUCTION OF HIGH-EFFICIENCY Ge(Li) DETECTORS. Kaye, J. H.; Brauer, F. P.; Fager, J. E.; Rieck, H. G. Jr. (Battelle Pacific Northwest Labs., Richland, WA). Nucl. Instrum. Methods; 113: No. 1, 5-14(1973).

The sources of background contributions for several large Ge(Li) detectors have been measured. A typical detector background is made up of roughly 30% contribution from cosmic radiation, 60% from shielding materials and 10% from radioactivity within the detector and other contributions. Background due to

detector components may be reduced significantly by careful design and selection of materials, and in particular by use of shielding between molecular sieve and the diode. Mercury may be placed around the detector to further reduce the background. Cosmic radiation effects can be reduced through either anti-coincidence counting techniques or by use of massive shielding. Where the method can be utilized, beta coincidence techniques will drastically reduce the background of Ge(Li) detectors, especially in conjunction with anticoincidence shielding. (auth)

7780 X RAYS AND SEMICONDUCTOR DETECTORS. Fioroni, P.; Gislon, R. Ing. Nucl.; 13: No. 4, 19-25(1972). (In Italian).

The principal stages in the development and use of semiconductor detectors are summarized. The origin of x rays is considered. The use of semiconductor detectors in the detection of plutonium and low-energy β particles is described. Analysis by fluorescence of the material is shown. Additional applications are cited and extension of the measurement toward low energies is indicated. (JSR)

7781 DETECTION AND DOSIMETRY OF IONIZING PARTICLES. Cellulose Nitrate Based Type II Kodak LR 115 Film. Barbier, J. (Societe Kodak-Pathe, Paris). Radioprotection; 8: No. 1, 51-57(1973). (In French).

A new solid track detector consisting of Type II Kodak LR 115 film is described. Instructions for its use are given together with its limitations. A sensitivity testing method was proposed in view of the requirements encountered in the measurement of very low activities when performing human dosimetry of weakly radioactive substances. The extreme sensitivity of this film and its selectivity in relation to certain radiations and ionizing particles enable its use to be envisaged in various domains, such as, uranium prospecting or in conjunction with a neutron beam for the mapping of boron or lithium inside mineral or organic samples. (FR)

7782 DUAL SPACED EPITHERMAL NEUTRON DETECTOR POROSITY LOGGING. Scott, H. D.; Smith, M. P. (to Texaco Inc.). U. S. Patent 3,774,033. 20 Nov 1973. Filed date 17 May 1972. 8p.

An illustrative embodiment of the invention includes method and apparatus for making earth formation porosity measurements in open or cased well boreholes. A high intensity (1.69×10^5 n/s) californium-252 neutron source is used to irradiate earth formations surrounding a well borehole with high-energy neutrons. As the high-energy neutrons interact with the materials comprising the earth formation their energy is reduced and some having epithermal energy are deflected back into the borehole at spaced distances from the neutron source. Two epithermal energy neutron detectors spaced at different vertical distances from the neutron source and from each other are used to measure the epithermal neutron population at the different distances. The ratio of the counting rates in the two detectors may be interpreted in terms of earth formation porosity by means of a predetermined relationship. (Official Gazette)

7783 APPARATUS FOR MEASURING RADIATION. Valkovisky, V. V. (to Compteurs-Schlumberger). U. S. Patent 3,760,187. 18 Sep 1973. Priority date 12 Feb 1971, France. 6p.

The radiation measuring apparatus comprises two absorbent cavities each having a geometrical form of revolution of general trunconical shape with reflecting lateral walls, the outer base being provided with an axial orifice forming a passage for the radiation to be measured and the inner base comprising the central junctions of a star-shaped thermopile. A window transparent to the radiation is disposed between these two bases, and the two cavities are assembled on their inner base by means of a support. (Official Gazette)

7784 RADIATION MONITORING SYSTEM. Battist, L. U. S. Patent 3,767,915. 23 Oct 1973. Filed date 14 Oct 1970. 10p.

A radiation monitoring system which continuously detects and measures low levels of radiation and radioactive materials in the surrounding atmosphere comprises a large volume multiple scintillation beta radiation detector with an alpha particulate radiation scintillation detector, and with background reduction being achieved by the use of an anti-coincidence cosmic ray and high energy photon shield. The use of coincidence and anti-coincidence pulse techniques and passive logic circuitry reduce background and electronic noise. The beta radiation and alpha radiation detectors have their output connected to a ratio circuit to continuously generate an output signal indicative of the ratio of alpha radiation to beta radiation. The cosmic ray detector generates an inhibiting signal to block the output of the beta detector to prevent it from recording its response to naturally occurring cosmic radiation. (Official Gazette)

7785 GAMMA CAMERA WITH INCREASED RESOLUTION. Mallard, J. R.; Wilks, R. J. (to National Research Development Corp.). U. S. Patent 3,774,031. 20 Nov 1973. Priority date 5 Aug 1968, United Kingdom of Great Britain and Northern Ireland. 6p.

An apparatus for use in investigating the distribution of radiation from an extended source consists of a multichannel collimator which is so mounted as to be movable in a plane substantially at right angles to the axis of collimation. A gamma camera is described which consists of such a collimator for collimating gamma radiation in association with a scintillation screen, an image intensifier vacuum tube, and means for forming an image of the distribution of light emitted by the scintillation screen upon the photo-cathode of the image intensifier. (Official Gazette)

Radiation Dosimeters

Refer also to abstract 7877.

7786 RADIOTHERMOLUMINESCENCE DOSIMETERS AND MATERIALS THEREFOR. Kotera, N.; Nishikawa, S.; Sakamoto, H. (to Dai Nippon Toryo Kabushiki Kaisha). US Patent 3,769,510. 30 Oct 1973. Filed Date 27 Apr 1972. 10p.

A complex oxide luminescent material consisting of magnesium oxide–silicon dioxide and containing trace amount of terbium or cerium as an activator shows strong thermoluminescence with glow peak at ca. 190°C under excitation by means of electron beam or various radiations and thus is useful as the phosphor for a thermoluminescent dosimeter. (Official Gazette)

7787 PROTON DOSIMETER DESIGN FOR DISTRIBUTED BODY ORGANS. Khandelwal, G. S. (Old Dominion Univ., Norfolk, VA); Wilson, J. W. Nucl. Technol.; 20: No. 1, 64-67 (Oct 1973).

The design of a real-time rem-rad dosimeter with sufficient generality for inclusion of dose distribution factors for space applications is discussed. This generalized dosimetric system is only slightly more complex than dosimeters in current use. (auth)

7788 COMPLEX THERMOLUMINESCENCE DOSIMETER. Yamashita, T.; Yamamoto, O.; Oonishi, H.; Kawabata, H.; Kitamura, S. (to Matsushita Electric Industrial Co., Ltd.). US Patent 3,761,710. 25 Sep 1973. Priority date 15 Apr 1961, Japan. 2p.

A complex thermoluminescence dosimeter is described, comprising a plurality of thermoluminescent elements secured to a single frame, whereby the accuracy of measurement can be increased and the handling can be simplified. The present dosimeter is particularly useful for a general analysis of ionizing radiations including measurement of neutrons. (3 Claims, 6 Drawing Figures) (Official Gazette)

7789 INTERPRETATION OF VALUES MEASURED THROUGH BALL MODERATOR DOSIMETERS AS NEUTRON DOSE EQUIVALENTS OF BODY SURFACES. Rossbander, V.; Adler, B. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 9: No. 3, 105-108(Mar 1973). (In German).

Recent neutron dose equivalent distribution data applied to a cylindrical phantom are compared to the standard data of NCRP-report No. 20, and the deviations of new "radiation protection guide" values from those recommended in 1957 are indicated. Possible corrections are of no importance in practical health physics. Comparison of normalized dose equivalent rates (a) as local dose rates, (b) as load of various body volume elements estimated using some simple method, and (c) as values calculated on the basis of the indications of ball moderator dosimeters, is made to show that in scattered neutron fields ball moderator dosimeters do not undervalue the radiation dose of body surfaces, while with the 10" method they may overrate it. Based on estimations of the energy and directional distribution in scattered neutron fields the said method provides a simple interpretation of dosimeter indications. (auth)

7790 DETERMINATION OF THE DOSE-RATE DISTRIBUTION AROUND LARGE γ-IRRADIATION SOURCES. Zsuzsanna, H.; Vilmos, S.; Gabor, F.; Pal, F. pp 41-62 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

Silicon diodes are being used for rapid dose-rate estimations, while permanent dose-rate measurement is carried out with chemical dosimeters. The chlorobenzene dosimetry technique was improved in order to document sterilizing doses. A computerized data-processing program has been worked out for plotting isodose charts. (auth)

7791 FAST-NEUTRON DOSIMETRY BY SOLID-STATE TRACK DETECTORS. Khan, H. A. (Univ. of Birmingham, Eng.). Nucl. Instrum. Methods; 113: No. 1, 55-60(1973).

Various plastic Solid-State Track Detectors (SSTDs) commonly used for the detection of light charged particles have been examined for their use in fast-neutron dosimetry. It is observed that more and more etched tracks are accumulated as the etching process is prolonged and that this increase in number of etchpits is quite sensitive to etching interruptions. The detection sensitivity of these detectors for various combinations of energy, etching time and angle of incidence of neutrons has been determined. Also, attempts have been made to explore the neutron spectrometric characteristics of these detectors. (auth)

7792 SOLID-STATE IONIZATION CHAMBER FOR THE HIGH-DOSE-RATE MEASUREMENT OF GAMMA RAYS. Tanaka, R. (Japan Atomic Energy Research Inst., Takashi); Tajima, S.; Usami, A. Int. J. Appl. Radiat. Isotop.; 24: No. 11, 627-637(Nov 1973).

A radiation damage-resistant γ-dose-rate meter in the form of an N/P-type silicon solar cell was investigated as a solid-state analogue of a gaseous ionization chamber. The ionization current was found to be a linear function of exposure rate in the range of $10^2 \sim 10^6$ R/hr. The sensitivity of the Cu-doped cell, with a bulk resistivity of 200 Ω-cm, is the most stable, and the sensitivity degradation rate is only about 0.1% 10^6 R. The sensitivity can also be stabilized to some degree by pre-irradiation. The temperature dependence in various cells was found to be less than 0.4%/°C between 5° ~ 60°C. The non-directional dependence of the dosimeter probe was established to an accuracy of about ±1%. (auth)

7793 CHEMICAL DOSIMETER OF ^{60}Co-LABELLED SODIUM ETHYLENEDIAMINETETRAACETATE Co(III) SOLUTION. Yang, M. H.; Tseng, C. L. (National Tsing Hua Univ., Hsinchu, Taiwan). Int. J. Appl. Radiat. Isotop.; 24: No. 11, 639-644(Nov 1973).

A chemical dosimetry making use of radiolysis of ^{60}Co-labelled ethylenediaminetetraacetate Co(III) solution is described. The cobalt ion which was produced by γ-irradiation was separated from the complex ion by cation-exchange separation method. The percentage of radiolytic yield of ^{60}Co ion which was obtained by the radioactivity measurement of both fractions of cobalt ion and complex ion was found to increase linearly with γ-radiation dose. For the dosimeter concentration of 1×10^{-2} M, the response curve was found keeping linearity with the dose throughout the range 3×10^3 to 3×10^6 rad. The G-value is 1.06 ± 0.04. The present dosimetric system by using radioactive ^{60}Co as tracer and coupling with ion-exchange separation is found useful for routine radiation monitoring of medium level γ-dose with relative simplicity and high reproducibility. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 7726 and 7855.

7794 (AERE-R-7512) CORRECTIONS TO THE DETECTION EFFICIENCY OF ^{6}Li SEMICONDUCTOR SANDWICH SPECTROMETERS. Clements, P. J. (UKAEA Research Group, Harwell, Atomic Energy Research Establishment). Oct 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

^{6}Li semiconductor sandwich spectrometers are used for the measurement of neutron spectra in a variety of applications. In the past, several spectrometer designs of differing internal construction have been used with little attention being paid to the scattering properties of the construction materials. It has now been shown that neutron scattering in the materials surrounding the sensitive region of the spectrometer can lead to backgrounds as high as ~35% in one particular design. (auth)

7795 (AWRE-O-31/73) USE OF SPHERICAL PROPORTIONAL COUNTERS FOR NEUTRON SPECTRUM MEASUREMENTS. Kemshall, C. D. (UKAEA Weapons Group, Aldermaston, Atomic Weapons Research Establishment). Sep 1973. 83p. Dep. NTIS (U. S. Sales Only) $6.25. £1.50.

A method is described for obtaining neutron spectra measurements by analyzing proton recoil distributions produced by spherical proportional counters. An investigation of the various errors to which the method is susceptible shows that an accuracy of better than 5% is attainable if all known corrections are applied. (auth)

7796 (JINR-P10-7366) EXPRESS PROGRAM FOR PROCESSING EPOS SPECTRA. Fitting Isolated and Weakly Overlapping Peaks. Eler, G.; Gopych, P. M.; Vinel, G. V.; Khabenikht, V.; Vylova, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A procedure was described for fitting isolated peaks and groups of weakly overlapping peaks. The procedure was developed on the basis of the statistical fitting method. This procedure is a basic part of the EPOS program. Because of the mathematical simplicity of this method, it is characterized by high processing speed and does not contain limitations arising during the use of iteration procedures. As a result of the fitting in an optimum time, a precision corresponding to the statistical precision of the experimental data is obtained. The basic part of the algorithm, using the statistical fitting method, is given in the form of a procedure in the Algol-60 language. (tr-auth)

7797 (N-73-20490) ELECTRON-PROTON SPECTROMETER: SUMMARY FOR CRITICAL DESIGN REVIEW. (Lockheed Electronics Co., Inc., Houston, Tex. (USA). Houston Aerospace Systems Div.). 1972. 402p. (NASA-CR-128814; EPS-473). NTIS.

The electron-proton spectrometer (EPS) is mounted external to the Skylab module complex on the command service module. It is designed to make a 2 pi omni-directional measurement of electrons and protons which result from solar flares of enhancement of the radiation belts. The EPS data will provide accurate radiation dose information so that uncertain relative biological effectiveness factors are eliminated by measuring the external particle spectra. Astronaut radiation safety, therefore, can be ensured, as the EPS data can be used to correct or qualify radiation dose measurements recorded by other radiation measuring instrumentation within the Skylab module complex. The EPS has the capability of measuring an extremely wide dynamic radiation dose rate range, approaching 10 to the 7th power. Simultaneously the EPS has the capability to process data from extremely high radiation fields such as might be encountered in the wake of an intense solar flare. (auth)

7798 (RISO-M-1662) SIMPLE MOESSBAUER CRYOSTAT BASED ON THE "COLD-FINGER" PRINCIPLE. Frees, L. A.; Fenger, J. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

The construction and performance of a simple, inexpensive cryostat of the "cold-finger" type is described. It is specifically intended for Moessbauer measurements between −195 and +50°C; the accuracy is better than ±0.5°C. (auth)

7799 DEVICE FOR DETERMINING THE ENERGY OF CHARGED PARTICLES. Staib, P. G. US Patent 3,760,186. 18 Sep 1973. Priority Date 25 Jan 1971, F. R. Germany. 6p.

A device for determining the energies of charged particles, such as Auger electrons, comprises at least one curved or domeshaped electrode biased to converge the paths of particles which are emitted by a particle source into a solid angle spanned by said electrode. The electrode is convex toward the particle source and cooperates with a similar, fairly closely spaced second electrode, and with a bias source connected to said electrodes to produce a particle accelerating field between them, to focus particles of a predetermined energy into a particle detecting device. (Official Gazette)

7800 WELL LOGGING SYSTEM WITH LINEARITY CONTROL. Jones, J. M. (to Texaco Inc.). US Patent 3,767,921. 23 Oct 1973. Filed Date 31 Mar 1972. 10p.

An illustrative embodiment of the present invention includes method and apparatus for gamma ray spectroscopy well logging systems including a closed loop linearity control feature. A borehole tool provides gamma ray pulse data. The gamma ray counts in at least two portions of the gamma ray energy spectrum chosen so that their ratio remains relatively constant under usual borehole conditions are monitored. An error signal is developed if the ratio of gamma ray counts in the monitored portions of the energy spectrum deviate significantly from the constant ratio. The error signal is used to control the power supply voltage for the borehole tool and/or the surface amplification of the gamma ray pulse signals to preserve system linearity. (Official Gazette)

7801 STATISTICAL METHOD FOR DETERMINATION OF THE PHOTOPEAK AREA OF SCINTILLATION γ-SPECTRA. Dimchev, T.; Evtimov, I. (Inst. of Physics, Sofia). Isotopenpraxis; 9: No. 3, 81-86(Mar 1973).

A comparatively unsophisticated analytical statistical method is developed for determination of the parameters of the peak of full absorption in processing scintillation γ-spectra. The general background under the photopeak is linearly approximated and an accuracy estimation was done. The method is illustrated with several applications of nondestructive γ-spectroscopic analysis of ^{137}Cs in soil samples. Concentrations of the order of several pCi ^{137}Cs are determined accurately enough under the disturbing influence of the peak of full absorption of RaC (^{214}Bi) at 610 keV. The control data was processed by means of a Minsk-22 computer

under a convenient program. The results correspond to those obtained according to the described method with a reliable estimation of accuracy. (auth)

7802 SEMICONDUCTOR SPECTROMETER WITH ACTIVE DIAPHRAGM. Solovev, S. M.; Eismont, V. P. (Radium Inst., Leningrad). Nucl. Instrum. Methods; 112: No. 3, 463-464(1973).

A semiconductor spectrometer with active diaphragm–semiconductor detector of toroidal shape–for removing the background pulses in the measuring detector is described. Such a diaphragm gives a sixfold decrease of scattered particle background intensity in the 1.5 MeV region in registration of ^{238}Pu α-particles. One expects that the use of a spectrometer with an active diaphragm will be more efficient in the case of higher energies. (auth)

7803 TWO INEXPENSIVE AUTOMATIC SAMPLE CHANGERS FOR USE WITH AN MCA. Erickson, J. J.; Eastwold, E. L.; Parker, J. F.; Baglan, R. J.; Larsen, K. H.; Brill, B. (Vanderbilt Hospital, Nashville). Nucl. Instrum. Methods; 112: No. 3, 597-599(1973).

Two inexpensive automatic sample changers for use with automatic-cycling multichannel analyzers with Ge(Li) gamma spectrometers are described. Both small dry samples and small liquid samples can be used. (auth)

7804 SINGLE AND DOUBLE ESCAPE PEAKS IN GE(LI) GAMMA-RAY SPECTRA. Johnson, J. R.; Mann, K. C. (Univ. of British Columbia, Vancouver). Nucl. Instrum. Methods; 112: No. 3, 601-602(1973).

The intensity ratios of both escape peaks to full-energy peaks have been measured for a 60 cm^3 Ge(Li) detector and compared with those for detectors of different volumes. (auth)

7805 METHOD FOR CORRECTING THE INFLUENCE OF ESCAPING EXTERNAL BREMSSTRAHLUNG ON β-SPECTRA MEASURED WITH 4π SOLID-STATE SPECTROMETERS. Wiesner, W.; Flothmann, D.; Gils, H. J. (Univ., Heidelberg). Nucl. Instrum. Methods; 112: No. 3, 449-454(1973).

Beta spectra measured with solid-state spectrometers are distorted by the escaping external bremsstrahlung, which is produced in the detectors. In a 4π arrangement of two Si(Li) detectors the effect, being negligible for low-energy β-spectra, requires a correction for β-spectra with endpoint energies above 1 MeV. The numerical corrections described are based on accepted data of bremsstrahlung spectra calculated by a Monte-Carlo program. The method consists in fitting a bremsstrahlung-distorted parametrized theoretical β-spectrum to the experimental spectrum. As results not only the corrected β-spectrum but also the shape-factor parameters and the endpoint energy are obtained. The working of the correction procedure is illustrated by some measured β-spectra with allowed and non-allowed shapes. (auth)

7806 APPLYING SYMBOLIC FORMULA MANIPULATION TO THE PROBLEM OF NON-LINEAR LEAST SQUARES. Wolberg, J. R.; Isenberg, J. (Technion–Israel Inst. of Tech., Haifa). Nucl. Instrum. Methods; 112: No. 3, 533-537(1973).

Symbolic formulation manipulation is a computer technique for manipulation of equations while still in symbolic form. For example, a symbolic formula manipulator is capable of differentiating X^2 to obtain 2X. This technique has been applied to the non-linear least-squares problem, and the resulting computer program is discussed. The fitting function is entered as data and all associated derivatives are obtained symbolically within the program. The program then proceeds to evaluate the functions and derivatives as required to obtain the least-squares estimates of the unknown parameters of the fitting function. For a given set of experimental data, the user can try a wide variety of fitting functions and compare goodness-of-fit. He thus has a sophisticated tool for performing a complex statistical analysis of his data without getting bogged down in the details. (auth)

7807 ASYMMETRY OF MOESSBAUER LINES DUE TO THE FINITE DIMENSIONS OF THE SOURCE. Mitrofanov, K. P.; Gor'kov, V. P. (Moscow State Univ.). Nucl. Instrum. Methods; 112: No. 3, 427-429(1973).

A calculation of Moessbauer spectra has been made for various experimental geometries. The line asymmetry observed at a "poor" geometry is shown to increase abruptly with the size of the source. The origin of the asymmetry is discussed and the extent of the spectral line distortion is estimated. (auth)

7808 CORRECTIONS FOR POSITRON ANNIHILATION IN FLIGHT IN NUCLEAR SPECTROMETRY. Kantele, J.; Valkonen, M. (Univ. of Jyvaeskylae, Finland). Nucl. Instrum. Methods; 112: No. 3, 501-505(1973).

Theories of positron single- and two-quanta annihilation in flight, the Fermi beta-decay theory, and theories of positron energy loss are used in calculations of total probabilities of annihilation in flight of positrons in continuous spectra. The results are given in a nomogram useful in correcting for positron annihilation in flight in various nuclear-spectrometry experiments. Confirmation of the theoretical basis employed was obtained by comparing total absolute probabilities for annihilation in flight of ^{62}Cu positrons in Perspex, copper, cadmium and lead, using a new differential method. The agreement with the theory was found to be excellent. A method for obtaining "correct" positron energy spectra with scintillation or semiconductor detectors is proposed. (auth)

7809 SIMPLE ALGORITHM FOR DETECTION OF SIGNIFICANTLY BROAD PEAKS. Kosina, Z. (Inst. of Nuclear Physics, Prague). Nucl. Instrum. Methods; 113: No. 1, 153(1973).

A method for a statistically founded comparison of the experimental values with the expected values of the fwhm is suggested, using a simple formula to estimate this quantity from three points of the peak. (auth)

7810 USE OF TRANSISTORS FOR DETECTION OF NUCLEAR RADIATION. Arpad, V.; Istvan, P. pp 21-40 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

A Ge(Li) solid state detector has been used for checking the purity of radiopharmaceuticals also, the energy and intensity of α-, β- and γ-rays emitted by radioisotopes and radioactive products and also their radioactivity were measured by means of several types of silicon diode 5. (auth)

7811 TIME-INVARIANT LINEAR TECHNIQUE FOR PRODUCING SIGNALS WITH FAST RECOVERY TIME. Taccetti, N.; Bocciolini, M. (Univ., Florence). Nucl. Instrum. Methods; 113: No. 1, 69-75(1973).

A linear delayed subtraction technique, which permits to obtain signals with fast recovery time and good noise/signal ratio, is described. The case of the compensated DL–RC circuit is discussed in detail. Some applications of the proposed technique are discussed, particularly in gamma spectroscopy. (auth)

7812 GENERAL APPROACH TO THE CALIBRATION OF A Ge(Li) GAMMA SPECTROMETRY SYSTEM FOR MEASUREMENT OF ENVIRONMENTAL AND BIOLOGICAL SAMPLES. Laichter, Y.; Notea, A.; Shafrir, N. H. (Israel Inst. of Tech., Haifa). Nucl. Instrum. Methods; 113: No. 1, 61-67(1973).

Environmental and biological samples containing radioactive debris may differ widely in their elementary composition and density. Due to their large volume, self-absorption and geometry are of major importance in data processing. In classifying the samples into four groups according to origin, relative constancy of the γ mass attenuation within 1% in each group is achieved. Universally practical calibration standards were prepared by contaminating seawater samples and evaporating to dryness. These standards were used for analyzing any environmental and biological samples–even of undetermined elementary composition–through proper correction for differences in density and mass attenuation. (auth)

7813 PHONON MEASUREMENTS ON A FILTER-DETECTION SPECTROMETER AND ITS RESOLUTION FUNCTION. Thaper, C. L.; Dasannacharya, B. A.; Iyengar, P. K. (Bhabha Atomic Research Centre, Bombay). Nucl. Instrum. Methods; 113: No. 1, 15-28(1973).

The use of a filter-detector spectrometer for accurate measurements of phonon dispersion curves is demonstrated. Two possible approaches–the "average energy" and the "cut-off energy"–have been examined experimentally as well as theoretically and it is shown that the former approach is consistent and reliable. Expressions for the resolution function and phonon shapes have been derived. The calculations reproduce the observed neutron groups in most cases. Focussing of the neutron groups, both in constant-Q and constant-E modes of operation, has been demonstrated by a number of examples and supported by theoretical calculations. (auth)

7814 CODES FOR PLOTTING SPECTRA. Geza, S. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 3, 195-200(1973). (In Hungarian).

It is desirable in the analysis of observed spectra, even in case of an automatic analysis, to produce the spectra in advance in permanent form. Two FORTRAN programs to carry out this task in different primary respects are presented. (RWR)

7815 MATHEMATICAL METHODS FOR PROCESSING NUCLEAR GAMMA RESONANCE SPECTRA. Ovsyannikov, E. A.; Shpaer, A. G. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 105-113 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Mos-

cow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The basic mathematical methods for interpretation of nuclear γ resonance spectra were examined. The efficiency of the methods described was demonstrated, on a series of simulated spectra and the suitable area for the use of each of them was indicated. (tr-auth)

High Energy Physics Instrumentation

7816 (COO-2232-18-Ex) ADDENDUM TO: PROPOSAL FOR A CONTINUATION WITH INCREASED SENSITIVITY OF A SEARCH FOR $e^{\pm}$, $e^{+}e^{-}$ PAIRS, HIGH TRANSVERSE MOMENTUM π^{0}, AND MULTIPLE PION CORRELATIONS IN COLLISIONS WITH HIGH TRANSVERSE MOMENTUM. (European Organization for Nuclear Research, Geneva (Switzerland); Rockefeller Univ., New York (USA)). 8 Oct 1973. 17p. Dep. NTIS $3.00.

The apparatus proposed by the CERN–Columbia–Rockefeller collaboration to search for $e^{\pm}$, $e^{+}e^{-}$ pairs, high transverse momentum π^{0}, and multiple pion correlations in collisions with high transverse momentum at the CERN ISR is described. The apparatus consists mainly of a superconducting solenoid magnet, a system of drift chambers, and two arrays of lead-glass total absorption Cherenkov counters. The solenoid, the trigger, and the drift chamber are described. Design parameters and cost estimates are listed. (WHK)

7817 (EFI-ME-7(72)) TRACK STORAGE IN WIDE SPARK CHAMBER FOR A TIME UP TO 1 MILLISECOND. Asatiani, T. L.; Zhirova, L. A.; Ivanov, V. A.; Krishchan, V. M. (Akademiya Nauk Armyanskoi SSR, Erevan. Institut Fiziki). 1972. 20p. (In Russian). INIS.

Consideration is given to the possibility of obtaining high-quality tracks of charged particles in a wide-gap spark chamber at large delays of ~1 millisec by means of double-pulse feeding and the use of various gas mixtures of Ne + (Ar, Kr, or Xe). It is shown that with double pulse feeding it is possible to attain quality tracks both for pure Ne and for mixtures of Ne + (Ar, Kr, or Xe) over a wide interval of delays from 20 microsec to 1000 microsec. (auth)

7818 (N-73-26580) RESEARCH INVESTIGATION ON DENSE SCINTILLATION GLASS FOR USE IN TOTAL ABSORPTION NUCLEAR CASCADE DETECTORS. Final Report. Hensler, J. R. (Bausch and Lomb Inc., Rochester, N.Y. (USA)). Jun 1973. Contract NAS9-11356. 10p. (NASA-CR-133960). NTIS $3.00.

Three approaches to the development of a high-density scintillation glass were investigated. They include the increase of density of glass systems containing cerium—the only systems which were known to show scintillation, the testing of a novel silicate glass system containing significant concentrations of silver produced by ion exchange and never tested previously, and the hot pressing of a diphasic compact of low-density scintillation glass with high-density passive glass. In first two cases, while ultraviolet excited fluorescence was maintained in the glasses showing high density, scintillation response to high-energy particles was not retained in the case of the cerium containing glasses or developed in the case of the silver-containing glasses. In the case of the compacts, the extremely long path length caused by the multiple internal reflections which occur in such a body resulted in attenuation even with glasses of high specific transmission. It is not clear why the scintillation efficiency is not maintained in the higher density cerium-containing glasses. (auth)

7819 (ORNL-TM-4349) RESPONSE OF A LARGE ALL-LIQUID SCINTILLATION SPECTROMETER AND OF A 24-LAYER IRON-PLASTIC SPECTROMETER TO CHARGED PIONS AND PROTONS IN THE LOW-GeV ENERGY RANGE. Gabriel, T. A.; Amburgey, J. D. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 69p. Dep. NTIS $5.50.

To aid in the design of a particular class of ionization spectrometers, calculations have been carried out to determine the response of a large all-liquid scintillation spectrometer to incident protons and charged pions in the low-GeV energy range. Included for comparative purposes is the calculated response of a 24-layer iron-plastic sandwich spectrometer of comparable gram/cm^2 thickness. The calculated data include spatially dependent energy deposition, spatially integrated contributions to the total energy deposition, leakage and binding energies, scintillation pulse-height distributions including and excluding saturation effects, and correlations between different variables. Also included for several cases is the calculated Cherenkov response. (auth)

7820 EVENT SELECTION IN A PROPORTIONAL-CHAMBER ARRAY USING LOOKUP TABLES. Gabriel, R. (Univ. of Chicago). Nucl. Instrum. Methods; 112: No. 3, 539-543(1973).

The coordinates from various pairs of planes in an array of proportional chambers in a two-arm spectrometer are compared in 400 ns using a combination of lookup tables and digital comparators. Only those with the "correct" (kinematically determined) correspondence are accepted. (auth)

7821 OPERATION OF SPARK CHAMBERS IN HIGH MAGNETIC FIELDS. Bradamante, F.; Conetti, S.; Daum, C.; Fidecaro, G.; Fidecaro, M.; Giorgi, M.; Penzo, A.; Piemontese, L.; Schiavon, P.; Vascotto, A. (CERN, Trieste, Italy). Nucl. Instrum. Methods; 112: No. 3, 513-518(1973).

The memory time of a spark chamber was measured in a 2.5 T magnetic field, and was found to be more than ten times larger than in the absence of a magnetic field. The lateral displacement of the spark was determined as a function of trigger delay and clearing field for magnetic fields up to 2.5 T. Good agreement was found with existing calculations. (auth)

7822 CONSTRUCTION OF A MULTIWIRE PROPORTIONAL CHAMBER HODOSCOPE. Comparat, V.; Chesneau, G.; Margaria, R.; Reide, F. (Inst. of Nuclear Physics, Orsay, France). Nucl. Instrum. Methods; 112: No. 3, 519-525(1973). (In French).

For the detection of medium-energy light particles, a 96 channel hodoscope has been built to be used in the focal plane of a magnetic spectrometer. The signal from a multiwire proportional chamber is coded by a fast addressing system coupled to a multichannel analyser. A spatial resolution of 1 mm and a time resolution of 20 ns have been obtained. The maximum counting rate is about 0.2 MHz. The amplification circuit for each wire is adjusted to obtain the same efficiency with a precision of 3%. Several experiments with scattered protons, deuterons, ^{3}He and α-particles have been performed over a wide range of targets. The stability and the viability of the wire chamber are quite good. (auth)

7823 HIGH INTENSITY OPERATION OF MULTIWIRE PROPORTIONAL CHAMBERS. Cavalli-Sforza, M. (Univ., Pavia, Italy); Goggi, G.; Ash, W. W.; Cheng, D. C.; Coyne, D. G.; O'Neill, G. K. Nucl. Instrum. Methods; 113: No. 1, 87-92(1973).

A system of 17 multiwire proportional chambers operated in a 28.5 GeV/c proton beam with intensities up to 10^{6} particles/s for a total integrated intensity of 10^{12} protons is discussed. Data for both low (~10^{4} protons/s) and high intensity beams are presented; no variation of efficiency was seen as a function of instantaneous integrated intensity; some variation was seen in the frequency of double firing. Results are also presented on the dependence of firing multiplicity on angle of incidence and on track ionization (up to 7 times minimum). (auth)

7824 MODULAR DATA ACQUISITION SYSTEM FOR MULTIWIRE PROPORTIONAL CHAMBERS. Cavalli-Sforza, M. (Univ., Pavia, Italy); Cheng, D. C. Nucl. Instrum. Methods; 113: No. 1, 81-86(1973).

A simple MWPC electronics system, in which most of the electronics is mounted on the chambers, is described. The system uses latches for temporary pulse storage and offers buffering options for data transfer to computer and tape. It has been in use for one year in an intense proton beam at the Alternating Gradient Synchrotron of Brookhaven National Laboratory, serving a total of 3100 wires. (auth)

Radiometric Instruments

Refer also to abstracts 7734 and 7855.

7825 (EURISOTOP-77) POSSIBILITY OF THE UTILIZATION OF RADIOMETRIC MEASURING METHODS IN THE TEXTILE INDUSTRY. Luenenschloss, J. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). 1973. 245p. (In German). Dep. NTIS (U. S Sales Only) $14.25.

Eight papers on the use of radiometric methods in the textile industry are compiled. The topics discussed include general aspects of the use of radiometry in the textile industry, metering elements on spinning machines and in uniform testing with special consideration of radiometric techniques, use of radiometric methods in weaving and weaving preparation, control systems in the textile equipment with special consideration of radiometry, use of radiometric methods in lace production, radiometric methods in the synthetic fiber industry, nuclear technique analysis methods in the textile industry, and the use of radiometry in the textile industry. (JSR)

7826 GAUGE FOR DETERMINING THE PERCENTAGE BY WEIGHT OF MOISTURE CONTAINED IN A BULK MATERIAL TRANSPORTED ON A MOVING CONVEYOR. Listerman, P. L. (to Ohmart Corp.). US Patent 3,761,712. 25 Sep 1973. Filed date 11 May 1971. 18p.

A moisture gauge is described including a radiation source for irradiating with fast neutrons and gamma radiation a bulk substance having moisture contained therein, an analog detector responsive to gamma radiation which has interacted with a pre-

determined fractional cross-sectional area of the bulk substance to produce a first electrical signal of an analog-type, the amplitude of which is correlated to the instantaneous total weight of the bulk substance including contained moisture, and a pulse-type detector which is responsive to slow neutrons generated by the interaction of fast neutrons and hydrogen atoms of the contained moisture in said predetermined fractional cross-sectional area to produce a second electrical signal of a pulse-type, the pulse rate of which is correlated to the weight of the moisture contained in the bulk substance. The electrical signals generated by the pulse-type slow neutron detector and the analog-type gamma detector are separately accumulated for predetermined intervals, with the slow neutron and gamma accumulating intervals being both equal and synchronized and preferably in the range of 20–80 seconds. An electrical circuit divides the successive moisture weight accumulation signals and the successive total weight accumulation signals to provide successive outputs correlated to the percentage by weight of moisture contained in the bulk substance passing through the gauge during the successive accumulation intervals. (6 Claims, 19 Drawing Figures) (Official Gazette)

7827 REFLECTION TYPE RADIATION THICKNESS METER. Kido, H.; Saito, S.; Kimoto, T. (to Tokyo Shibaura Electric Co. Ltd.). US Patent 3,767,920. 23 Oct 1973. Filed date 16 Aug 1971. 10p.

A thickness measuring apparatus is described including a radiation detector to provide an ionization current corresponding to radiation reflected by a substance whose thickness is to be measured and placed on a substrate sufficiently thick to saturate radiation reflected therefrom, and a reference unit to provide an electric quantity of opposite polarity and equivalent to the ionization current generated by a sample of the same material as the substance sufficiently thick to saturate radiation reflected therefrom. A zero thickness point of the substance mounted on the substrate upon actual determination is so pre-adjusted, before actual determination, as to define the output level from the radiation detector which faces a sample of the same material as the substance sufficiently thick to saturate radiation reflected therefrom. The difference between the ionization current from the radiation detector which faces the substance placed on the substrate and whose thickness is to be measured substituting for the sample following the pre-adjustment and the electric quantity from the reference unit is applied to an indicating meter through a logarithmic amplifier. (9 Claims, 6 Drawing Figures) (Official Gazette)

7828 METHOD OF TESTING FOR LEAKS IN LOW DENSITY ARTICLES. Lange, W. H. (to General Motors Corp.). US Patent 3,764,811. 9 Oct 1973. Filed date 4 May 1972. 4p.

Plastic foam carburetor floats are inspected for leaks by subjecting the floats to a radiopaque solution (e.g., zinc chloride), under pressure to impregnate those floats having leaks, then irradiating each float with gamma rays from an americium 241 source and detecting the intensity of the transmitted radiation by a scintillation detector or Geiger counter. Those floats having leaks transmit a detectably smaller amount of radiation than good floats. (3 Claims, 2 Drawing Figures) (Official Gazette)

7829 MEASURING DENSITY BY BETA-PARTICLE ABSORPTION. Parkinson, M. J. (to British Coal Utilization Research Association Ltd.). US Patent 3,766,379. 16 Oct 1973. Priority date 5 Jun 1968, United Kingdom of Great Britain and Northern Ireland. 6p.

In measuring the density of a gaseous suspension of solid particles two or more sources of β-particles, a collimator and a single β-particle detector, are used to obtain a single reading which is a measure of the average density of the gaseous suspension. (Official Gazette)

7830 NUCLEAR GAGES FOR MONITORING THE COALBED OF COMMERCIAL-SCALE PRESSURIZED GAS PRODUCERS. Friggens, G. R.; Hall, A. W. Report of Investigations 7793. Washington; Dept. of the Interior (1973). vp.

A nuclear method for continuously monitoring the coalbed and ash levels and void formation in commercial-scale, fixed-bed, pressurized gas producers is proposed. Measurement of gamma ray transmission through the coalbed is the basis of the method. The coalbed level is monitored by detecting the transmission of gamma rays from a 1 to 2 Ci ^{60}Co source positioned on the outside wall of the vessel. Coal bridging or, alternatively, ash level is monitored by a 10 Ci ^{60}Co source at the center of the coalbed. Source activities and geometries are calculated for a 12-ft-ID producer designed to operate at 350 psi. Source capsule and detector specifications and operational safety are also discussed. (auth)

7831 GAMMA ABSORPTION DENSIMETERS AND THEIR INDUSTRIAL APPLICATION. Sandor, R.; Laszlo, V. pp 187-220 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

Following a general review of the densimetrical technique a summary is given of the applications successfully exploited at the Institute and the development of electronic units for the industrial nuclear densimeters designed there. Extensive use of integrated-circuit universal industrial ratemeters is expected in the near future. (auth)

7832 DETERMINATION OF MOISTURE IN GYPSUM-BEARING SOIL BY A NEUTRON METHOD. Appin, A. A. Tr. Vses. Nauch.-Issled. Inst. Gidrotekh. Melior.; No. 48, 51-54(1970). (In Russian).

Tabulated data (26 samples) are presented which compare the values for moisture in gypsum-containing soils found by a weight method on samples dried at 105°C with those found by a neutron method. The latter values are consistently higher than the former. The water of crystallization of gypsum is the difference between the weight at 80°C and that at 190°C. By using factory calibration curves which account for this moisture, the readings obtained with a neutron moisture meter can be corrected to give satisfactory results. (TTT)

7833 STUDY OF SURFACE COATINGS: CONTROL OF THICKNESSES AND DEPOSITS. Bernard, A. Maintenance; No. 34, 2-6(Jul 1973). (In French).

A brief review is given of various measurement processes currently used in industry, i.e., magnetic attraction, magnetic flux, eddy currents, thermoelectricity, β particle backscattering, x-ray gages, x-ray emission resulting from β particle bombardment, and x-ray fluorescence. The measurement of thicknesses by ultrasound and the detection of faults are then examined. The utilization of radioisotopes in industry is discussed together with detector development. (FR)

7834 METHODS FOR MEASURING MOISTURE IN SALINE SOILS USING NEUTRONS. Emel'yanov, V. A. Tr. Vses. Nauch.-Issled. Inst. Gidrotekh. Melior.; No. 48, 44-50(1970). (In Russian).

A neutron probe which contains both thermal neutron and capture gamma counters, for measuring the moisture and chlorine content, respectively, of saline soil, is described. The cadmium screen of the thermal neutron counter can be adjusted to allow counting of epithermal neutrons also, for use when anomalous absorbers (B, Li) are present which do not emit capture gamma radiation. For evaluating the neutron-neutron interference, a probe with two thermal neutron detectors at different distances from the source may be used, so that the thermal neutron count does not depend on the moisture. Experimental work verified the usefulness of such an instrument. (TTT)

7835 OPERATION OF A MOISTURE METER WITH AN EPITHERMAL NEUTRON DETECTOR. Rode, L. G.; Nechaev, O. M. Tr. Vses. Nauch.-Issled. Inst. Gidrotekh. Melior.; No. 48, 70-76(1970). (In Russian).

The use of epithermal neutrons instead of thermal neutrons to determine soil moisture was tested to eliminate the inference of other neutron absorbers, e.g., chlorine. The detector (LDNM) was a plastic cylinder with radial channels in which phosphors were pressed. Using a 0.1–Ci Pu–Be source in the laboratory, comparison of the LDNM with other counters (Cd and B) on moist sand, Al–K alums, and polyethylene showed that at least 65% of the radiation recorded by the LDNM is epithermal neutrons and that, by using two detectors, the free water and water of crystallization can both be determined. The LDNM was also shown to be much less sensitive to the presence of chlorine than were all other detectors tested. (TTT)

7836 PORTABLE NUCLEAR DENSITY-MOISTURE INSTRUMENT. Martin, J. R. (to Soiltest, Inc.). U. S. Patent 3,774,034. 20 Nov 1973. Filed date 12 May 1971. 6p.

A density–moisture instrument that has a two-piece housing and a radiation shield mounted to the flat-bottomed base of the housing is described. A capsule carrying a radioactive source is connected to a rotatable shaft by a flexible push-pull cable. The capsule is moved back and forth in an arcuate passage in the shield by the rotation of the shaft between a "safe" position (where there is no direct, unshielded line of sight from the outside of the housing to the source) and an "operate" position (where the source is located in an unshielded position adjacent the bottom of the housing). An actuator mounted on the shaft actuates an on-off switch so that the electrical system detecting the radiation back-scatter from the material being measured is energized only when the source is in the "operate" position. The shaft is rotated by a handle, which is also used to carry the instrument, and the source is in the

"safe" position when the handle is in the carrying position. (Official Gazette)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 8373 and 8375.

7837 (N-73-21083) EFFECTS OF ELECTRON IRRADIATION AND TEMPERATURE ON 1- AND 10-OHM-CM SILICON SOLAR CELLS. Nicoletta, C. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Mar 1973. 36p. (NASA-TM-X-66231). NTIS $4.00.

One ohm-cm and 10 ohm-cm silicon solar cells were exposed to 1.0 MeV electrons at a fixed fluence of 10^{11} e/cm^2/s and a flux of 10^{13}, 10^{14}, and 10^{15} e/cm^2. I-V curves of the cells were made at room temperature, −63°C and ±143°C after each irradiation. A value of 139.5 MW/cm^2 was used as AMO incident energy rate per unit area. The 10 ohm-cm cells appear more efficient than 1 ohm-cm cells after exposure to a fluence > 10^{14} e/cm^2. The 1.0 MeV electron damage coefficients for both 1 ohm-cm and 10 ohm-cm cells are somewhat less than those for previously irradiated cells at room temperature. The values of the damage coefficients increase as the cell temperatures decrease. Efficiencies pertaining to maximum power output are about the same as those of n on p silicon cells evaluated previously. (auth)

7838 RADIATION RESISTANT LITHIUM FERRITE CORES. Baltzer, P. K. (to RCA Corp.). US Patent 3,767,581. 23 Oct 1973. Filed date 31 May 1967. 6p.

A neutron radiation resistant ferrite core comprising a ferrite which contains lithium isotopically enriched in ^{7}Li, and one or more of manganese, cobalt, or elements which decay under alpha particle bombardment to manganese or cobalt is described. (Official Gazette)

7839 AFTER EFFECTS IN IMPATT OSCILLATORS WITH TRANSIENT IONIZING RADIATION. Borrego, J. M.; Gutmann, R. J.; Cottrell, P. E.; Ghandi, S. K. (Rensselaer Polytechnic Inst., Troy, NY). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 5, 675-676(May 1973).

Two types of aftereffects were observed in testing IMPATT diodes under ionizing radiation. The first type can be characterized by a 10 to 25-percent decrease in power and a 5 to 20 MHz change in oscillation frequency after the radiation pulse. The second type is characterized by a large change in oscillator performance (3 dB decrease in power and 1 GHz change in frequency) or irreversible diode failure, and occurred with two GaAs Schottky diodes. A strong cavity-RF load dependence has been demonstrated for the latter type of aftereffect. (auth)

Miscellaneous Instruments

Refer also to abstracts 8340 and 8900.

7840 (K-1849) MASS SPECTROMETER VACUUM-LOCK CARRIAGES COATED WITH TEFLON-S. Howard, O. H.; Langdon, A. (Oak Ridge Gaseous Diffusion Plant, Tenn. (USA)). 26 Nov 1973. Contract W-7415-eng-26. 8p. Dep. NTIS $4.00.

Seizing of the metal-to-metal, piston-like carriages of a thermal ionization mass spectrometer vacuum lock was eliminated by replacing 0.0015 in. of the carriage surface with Teflon-S. The vacuum lock has been operated 1600 times in the 3.5 years since the carriages were coated. Both the plastic surface and the mass spectrometer vacuum remain satisfactory. (auth)

7841 (RD/B/N-2751) INSTRUMENT FOR DETECTING GAS BUBBLES IN SODIUM FILLED PIPEWORK. Stapleton, D. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

An instrument employing an electromagnetic sensor is described. Gas bubbles down to 0.5 mm diameter can be detected in sodium filled pipework of 1 in. nominal bore at temperatures up to 400°C. Installation of the sensing head involves no break in the integrity of the pipework. Facilities to enable bubble size discrimination, bubble counting and timing pulse generation are provided in the signal processing unit. Initial operating experience has been gained on a sodium loop used for gas entrainment studies. (auth)

7842 (SLA-73-532) PRELIMINARY CHARACTERISTICS AND DEVELOPMENT REPORT FOR THE MC2789 INTERCONNECTING BOX, LIGHTNING ARRESTOR. Olson, H. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT-(29-1)-789. 46p. Dep. NTIS $4.50.

The MC2789 Interconnecting Box is an encapsulated package (approximately 6 cubic inches), containing a lightning arrestor connector (LAC) plus two JT02 connectors and is used in the W66 Sprint warhead. The LAC is the primary interconnection between the warhead and the DOD adaption kit. The design intent, product characteristics, environmental tests and development history are described. (auth)

7843 (Y-DA-5554) COMPARISON OF THE ION MICROPROBE WITH OTHER INSTRUMENTAL TECHNIQUES FOR SOLVING SURFACE DIFFUSION PROBLEMS. Cristy, S. S.; Annis, B. K. (Oak Ridge Y-12 Plant, Tenn. (USA)). 10 Oct 1973. Contract W-7405-eng-26. 27p. (CONF-731011-3). Dep. NTIS $3.50.

From 17th conference on analytical chemistry in nuclear technology; Gatlinburg, Tennessee, USA (23 Oct 1973).

The equipment and procedure for using an ion microprobe mass analyzer for studying surface diffusion and for measuring surface diffusion coefficients directly are described. Surface diffusion coefficients of 3×10^{-10} cm^2/sec and 2×10^{-10} cm^2/sec for La_2O_3 and SrO, respectively, on NaCl at 693°K, are reported. A summary comparison of the performance of the electron microprobe, heavy ion-induced fluorescence, spark source mass spectrometer, and the ion microprobe for surface diffusion studies is given. (WHK)

7844 RADIOLOGY SPECIAL PROCEDURE ROOM. Brinker, R. A.; Skucas, J. Baltimore; University Park Press (1973). 194p. $9.50.

Radiologic equipment requirements for vascular special procedures are reviewed. Topics discussed include the room itself, transformers and generators, tubes and their anodes, rapid film changers, screens and grids, image quality, image viewing and storage, injectors, film and processing, film viewing, and electrical safety. The handbook is meant to be a guide to current good practice for both the radiologist and the equipment designer. (WHK)

7845 MONITORING ATMOSPHERIC POLLUTANTS WITH A HETERODYNE RADIOMETER TRANSMITTER–RECEIVER. Menzies, R. T. (to National Aeronautics and Space Administration). US Patent 3,766,380. 16 Oct 1973. Filed date 24 Mar 1972. 12p.

The presence of selected atmospheric pollutants including radioactive particles can be determined by transmitting an infrared laser beam of proper wavelength through the atmosphere, and detecting the reflections of the transmitted beam with a heterodyne radiometer transmitter-receiver using part of the laser beam as a local oscillator. The particular pollutant and its absorption line strength to be measured are selected by the laser beam wave length. When the round-trip path for the light is known or measured, concentration can be determined. Since pressure (altitude) will affect the shape of the molecular absorption line of a pollutant, tuning the laser through a range of frequencies, which includes a part of the absorption line of the pollutant of interest, yields pollutant altitude data from which the altitude and altitude profile is determined. (4 Claims, 5 Drawing Figures) (Official Gazette)

7846 GEOMETRICAL FACTOR OF LARGE APERTURE HEMISPHERICAL ELECTROSTATIC ANALYZERS. Chase, L. M. (Univ. of California, Berkeley). Rev. Sci. Instrum.; 44: No. 8, 998-1002(Aug 1973).

A method for calculating the angular response, energy resolution, and geometrical factor of hemispherical electrostatic analyzers with large plate separations is presented. The method is applicable to analyzers with inside to outside plate radii ratios as small as 0.5. The effects of fringing fields near the analyzer apertures are considered in detail. (auth)

7847 IONIZING-TYPE FIRE ALARM SENSOR. Lampart, T.; Kuhn, M. (to Cerberus AG). US Patent 3,767,917. 23 Oct 1973. Priority date 23 Jul 1970, Switzerland. 8p.

A housing structure, made of metal, includes at least three interlocking parts, having interengaging elements which operate in different directions, in space, for example 1 and 2 being connectable by rotation in one direction, elements 2 and 3 being connectable by vertical movement and, if desired, rotation in another direction to permit ready disassembly of selected elements for cleaning and maintenance without, however, accidental dislodgment of the elements of the structure in case of fire or exposure to high temperature. The first part forms a socket; the second part includes an electric circuit and one portion of an ionization chamber with a radioactive substance; and the third part forms the other portion of the ionization chamber, containing no radioactive substances and shielding the second part from dust and dirt. (Official Gazette)

7848 30 cm RADIUS 90° SECTOR DOUBLE COLLECTING MASS SPECTROMETER WITH A CAPACITOR INTEGRATING DETECTOR FOR HIGH PRECISION ISOTOPIC ANALYSIS OF CARBON DIOXIDE. Beckinsale, R. D.; Freeman, N. J.; Jackson, M. C.; Powell, R. E.; Young, W. A. P. (Atomic Weapons Research Establishment, Aldermaston, Eng.). J. Mass Spectrom. Ion Phys.; 12: No. 3, 299-308(Oct 1973).

The long-term performance of a 30.48-cm-radius 90° sector double collecting mass spectrometer using a novel automatic capacitor integrating detector for high precision isotopic analysis of carbon dioxide is described. The incorporation of a new design of changeover valve in the dual inlet system and other aspects of the design of the mass spectrometer have resulted in the reduction of all the instrumental corrections applicable to measured isotopic differences between sample and standard gases to a negligible level. Isotopic differences in the ratio of ratios (46/(44 + 45)) sample − (46/(44 + 45)) standard/(46/(44 + 45)) standard can be determined routinely with a reproducibility (expressed as the 1σ standard deviation about the mean value obtained by replicate analysis) of better than ±0.002‰. The efficiency of the ion source is about 5×10^{-4} ions molecule^{-1}. The leak correction has averaged 0.004 ± 0.016‰ for the 46/(44 + 45) ratio and −0.025 ± 0.008‰ for the 45/44 ratio. The sums of all the other instrumental corrections (background, valve mixing, and abundance sensitivity) are 1.00038 for δ46/(44 + 45) values and 1.00078 for δ45/44 values. These values compare favourably with published sums of correction factors which average about 1.03. The capacitor integrating detector has the advantages that the ion beam intensities are objectively averaged, it runs the mass spectrometer automatically once set up, and provides a digital output. (auth)

7849 CAMAC BRANCH DRIVER: A PARTICULAR SOLUTION. Bernede, M. (EURATOM, Ispra, Italy); De Grandi, G.; Kalisz, J.; Stanchi, L.; Bettini, P.; Neglia, A. Nucl. Instrum. Methods; 112: No. 3, 527-532(1973).

A CAMAC branch driver conceived for use with a Laben 70 computer has been developed for a CAMAC system containing up to 7 crates. A particular interface is directly inserted into the computer and allows the dialogue with it. The branch driver can perform all the operations requested by the CAMAC standard and in addition has some special features such as: (a) Executive mode for operating a direct link between modules via crate controllers and branch highway. (b) Address scan for an unknown number of data where the end of scan is automatically given when the last module comprised in the scan is reached and there is a Q = 0. (c) Peculiar handling of LAM (look-at-me) signals in addition to the normal BD (branch demand). It can use three direct LAM's which can find direct subroutines associated to them or an optional module called "Interrupt Vector Generator" which can manage directly 28 subroutines corresponding to 28 individual LAM's. (auth)

7850 12 BIT ANALOG-TO-DIGITAL CONVERTER FOR PULSE HEIGHT ANALYSIS. Westphal, G. P. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Nucl. Instrum. Methods; 113: No. 1, 77-80(1973).

An ADC is described, which is of the successive approximation type and makes use of Gatti's sliding scale principle for channel width averaging. The use of commercially available modular converters for both the ADC and the averager DAC resulted in a very simple and reliable construction of high stability. Conversion time is 15 μs. Differential linearity is better than 0.2%. Integral linearity is less than 0.01% and gain stability is in the order of 10 ppM/°C. A mapping of the channel profile is given for both "averager off" and "averager on". No significant degradation of the channel profile due to the averager action could be found because of the good initial differential linearity of the ADC module. (auth)

7851 POLYCHROMATIC VISUALIZATION OF MOSAICS. Muser, A.; Lutz, J. R. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Instrum. Methods; 113: No. 1, 131-139 (1973). (In French).

It is now possible, with relatively modest means, to build polychrome data displays to add another dimension to data visualization. These displays are able to show single and multiparametric spectra in different modes (isometric, map, slice). The size of the displayed spectrum depends principally on the characteristics of the refresh memory. This latter can be suppressed by a wired program. The choice of the different options taken is discussed. (auth)

7852 MEASUREMENT OF THE DEAD-TIME IN A MULTICHANNEL ANALYSER. Mortensen, L.; Olsen, J. (Danish Atomic Energy Commission, Risoe). Nucl. Instrum. Methods; 113: No. 1, 151-152(1973).

By means of two simple measurements three different dead-times are determined: the normal dead-time, a dead-time coming from the pile-up, and a dead-time due to the finite width of the timing pulses. (auth)

7853 MEASURING AND CONTROL SYSTEM CAMAC. Decker, W. (Siemens AG, Karlsruhe, Ger.). Steuerungstechnik; 6: No. 2, 25-27(1973). (In German).

An international, standardized system for computerized measuring and control technique is described. The system setup including the dataway, and branch highway is presented. (GE)

7854 PERFORMANCES OF NEUTRON COLLIMATORS. II. Choice of the Parameters of a Primary Collimator. Poletti, G. (Informazioni Studi Esperienze, Milan); Rossitto, F. Acta Crystallogr., Sect. A; 29: No. 4, 440-444(1 Jul 1973).

The performance of a neutron primary Soller collimator is reviewed, taking into account the finite dimensions of the neutron source. The possibility of choosing suitable values of the parameters to optimize the performances of the collimator, both in intensity and in flux, is shown. A "figure of merit" for a collimator is discussed. Experimental data are in fair agreement with calculations. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

7855 IZOTOPTECHNIKAI KUTATASOK. (Studies in Isotope Technology). Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). 328p.

Sixteen papers are presented under the following headings: research and development, methodology, and technology. Fourteen of the papers were abstracted separately for NSA. The two remaining papers concerned multichannel level indicators and radioactive tracer studies on the homogeneity of mixtures. (DHM)

For abstracts of individual sections see: 7614, 7637, 7638, 7734, 7773, 7790, 7810, 7831, 7872, 7873, 7877, 7878, 7891, and 7987.

Isotope Separation (Industrial)

7856 (INIS-mf-854) PRODUCTION OF HEAVY WATER IN INDIA. Fareeduddin, S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 24p. INIS.

From symposium on nuclear science and engineering; Bombay, India (13 Mar 1973).

To meet the requirements of heavy water for the power reactors now under construction and those being planned, a program for providing adequate production capacity has been started. Various processes have been surveyed and the factors which have been considered in the choice of the processes adopted in India are presented. The H_2S-H_2O exchange process adopted for the plant being set up at Kota and the ammonia–hydrogen exchange process adopted for the Baroda plant are briefly described. The status of the various plants under construction has been presented. The operating experience of the Nangal plant during the last ten years is included. (auth)

7857 (LA-tr-73-52) METHOD FOR THE SEPARATION OF ISOTOPES. Oct 1973. Translation by A. Vakar of French Patent 2,119,214. 9p. Dep. NTIS $3.00.

A laser method for separating uranium isotopes is described. (TFD)

7858 (ORO-735) NEW ENRICHMENT PLANT SCHEDULING. (USAEC Oak Ridge Operations Office, Tenn.). Nov 1973. 23p. TIC.

This report discusses key elements in planning for new enrichment capacity based on AEC projections of separative work requirements. Long lead times for construction of additional enrichment capacity, and power procurement in the case of gaseous diffusion plants, require early planning in order that enriched uranium will be available to meet reactor fuel needs in the future. In addition to separative work supply and demand, planning elements include choice of enrichment process; capacity, number, and timing of new enrichment plants; construction scheduling of these new plants; power supply; and financial requirements. The scheduling of new enrichment plants is approached on a systematic basis to satisfy a total separative work market. It should be noted, however, that for any given new plant, the demand to be met by such plant, and therefore its capacity and schedule, will be determined by contracts between the plant owner-operator and his customers rather than by overall supply-demand projections. This report is an introductory overview. It indicates major management decision areas and is intended to permit industry management to apply their own assumptions and arrive at their own broad assessments regarding the number and capacity of enrichment plants needed, the scheduling of new plants, commitments for electrical power, and capital investment timing for new enriching plants. Updating of the information in this report will be made periodically. (auth)

7859 (UCRL-TRANS-10705) POSSIBILITY OF LASER ISOTOPE SEPARATION. Burjan, V. Translated from Cesk. Cas. Fys.; 22: 100-101(1972). 4p. Dep. NTIS $3.00.

The use of laser radiation for the separation of hydrogen and deuterium is briefly discussed. (TFD)

7860 THERMALLY INDUCED FLOW IN GAS CENTRIFUGE. I. Mikami, H. (Tokyo Inst. of Tech.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 7, 396-401(Jul 1973).

Centrifugally driven thermal convection near the cooled rotor cover of a centrifuge is treated. Boundary layer equations are reduced to ordinary differential equations by the Lees–Levy transformation, and solved numerically by applying the quasi-linearization method. Sample solutions for radial and azimuthal velocity profiles are presented. The values of the axial velocity at the rotor center are calculated as a function of the temperature difference between the rotor cover and the contained gas. (auth)

7861 PHYSICS OF URANIUM-235 ENRICHMENT IN THE SEPARATION NOZZLE PROCESS. III. Mechanisms of Entropy Production in the Separation Nozzle Flow. Bley, P.; Duerr, R.; Ehrfeld, W.; Eisenbeiss, G. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Naturforsch., 28a: No. 8, 1273-1280(1973). (In German).

The energy consumption of the separation nozzle process for enrichment of ^{235}U is discussed in terms of the entropy production in the separation system. Experimental results, obtained from measurements with Pitot type pressure probes and a numerical Navier-Stokes analysis of the nozzle flow, show that ordinary viscous dissipation is the most important entropy production mechanism. The relatively large amount of kinetic energy observed at the end of the nozzle indicates some possibilities of lowering the specific energy consumption of the process. (GE)

7862 COMMITTEE REPORT ON TECHNOLOGICAL DEVELOPMENT IN URANIUM ENRICHMENT. At. Jap.; 16: No. 11, 16-19(Nov 1972).

The Japan Atomic Energy Commission, following the report by its ad hoc committee, has decided on the research and technical development of uranium enrichment in Japan. Fundamental aspects of the gaseous diffusion method will be pursued in order to utilize it in a possible future international project. The centrifuge method, on the other hand, is promising because it is likely to become an internationally competitive venture in Japan, and such a plant will be completed by 1985. Programs of research and development for these two methods in Japan, undertaken by the committee, are described. (JA)

7863 PHYSICS OF URANIUM-235 ENRICHMENT IN THE NOZZLE PROCESS. II. Comparison of the Added Light Gases H_2, He, and D_2. Bier, W.; Eisenbeiss, G.; Heeschen, G. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Naturforsch., 28a: No. 8, 1267-1272(1973). (In German).

The effects of the addition of the light gases H_2, He, and D_2 on the separation of the uranium isotopes in the separation nozzle process are compared experimentally. The superiority of H_2 under economically optimum conditions turns out to be caused essentially by its less dissipative nozzle flow characterized by a higher Reynolds number. This advantage is decreased if differences in the flow velocity lose their effects on isotope separation, e.g., at higher expansion ratios. Thus, with He added, the isotope separation effects can get closer to those observed with H_2; D_2 even can get better than H_2, because He and D_2 prevent more efficiently the UF_6 from concentrating rapidly at the outer nozzle wall. (GE)

7864 ENRICHED URANIUM SITUATION IN EUROPE. Pecqueur, M. (CEA, Paris). Rev. Fr. Energ.; 24: No. 252, 272-278(Apr 1973). (In French).

The supply of enriched uranium in Europe is discussed. The balance between supply and demand is studied. The various possible solutions are then presented, e.g., American contracts; projects using ultracentrifuges; and projects using gaseous diffusion. (FR)

7865 PRODUCTION OF ISOTOPES ^{22}Ne AND ^{20}Ne AND ENRICHMENT OF ^{21}Ne BY MEANS OF RECTIFICATION AT 28°K. Bewilogua, L.; Verges, P.; Vinzelberg, H. (Zentralinstitut fuer Festkoerperphysik und Werkstofforschung, Dresden). Isotopenpraxis; 9: No. 3, 97-100(Mar 1973). (In German).

For production of neon isotopes in a larger scale the most suitable method is rectification. To provide an economical regime, the evaporator and condenser are connected with a neon cooling cycle. The column packing consists of spirals of stainless steel (1.6 mm × 1.8 mm × 0.2 mm) and has a height of 6000 mm. With twofold distillation the following concentrations were obtained: ^{22}Ne 99.3 per cent per volume (max. 99.5 per cent), ^{20}Ne 99.97 to 99.99 per cent per volume. ^{21}Ne was enriched to 1.2% per volume, i.e., to fourfold natural concentration. (auth)

7866 GAS SAMPLING DEVICE FOR AN ULTRACENTRIFUGE. Le Manach, J. (to Commissariat a l'Energie Atomique). French Patent 2,130,844. 23 Mar 1971. 8p. (In French).

A gas sampling device for an ultracentrifuge having a rotating cylindrical bowl closed at its ends which extend perpendicularly away from the axis of rotation, is described. These ends are connected to end parts which are in the form of open cylindrical chambers coaxial with the bowl and communicating with its interior. The chambers are smaller in diameter than the bowl. The device consists of many thin removable tubular elements positioned in channels provided directly in the side wall of the chambers connected to the ends of the rotating bowl. (FR)

7867 SUMMARY OF A REPORT ON THE CONSTRUCTION AND USE OF THE MAGNETIC ION SOURCE OF THE PRETORIA ELECTROMAGNETIC ISOTOPE SEPARATOR. Gries, W. H. (National Physical Research Lab., Pretoria). Nucl. Instrum. Methods; 113: No. 1, 147(1973).

The contents of a recently published report on the magnetic ion source in use on the electromagnetic isotope separator at Pretoria are summarized. (auth)

Isotopic Power Sources

7868 (MDC-G-4415) COMPATIBILITY AND STABILITY OF PLUTONIA-238 BASE CERMET FUEL FORMS IN REFRACTORY ALLOY CONTAINERS AT 1500° TO 2000°C. Watrous, J. D.; Ferguson, W. E. (McDonnell Douglas Astronautics Co., Richland, Wash. (USA). Donald W. Douglas Labs.). Sep 1973. Contract AT(45-1)-2138. 74p. Dep. NTIS $5.45.

The compatibility of two and stability of three plutonia-238 base cermet fuels were investigated at 1500° to 2000°C from July 1969 through November 1971, while these fuel forms were being developed for use in Radioisotope Thermoelectric Generators (RTG). Adequate containment, independent of fuel form, was achievable even at these very high temperatures. Fuel stability varied, but all three forms developed plutonia porosity and agglomeration of the metal network at the lowest test temperatures, which were well in excess of current RTGs. A Battelle-Columbus Laboratories plutonia-molybdenum cermet (BCL-PMC) developed as a precurser of the current PMC fuel form was investigated for stability at 1500° to 2000°C for times to 10,000 h. The thoria and molybdenum overcoated test specimens encapsulated in single W-25Re containers degraded with increasing time and temperature. The 1000-h specimens remained relatively intact; the 10,000-h specimens transported almost entirely to the container walls. The interim plutonia-thoria-molybdenum solid-solution cermet (SSC) fuel form lost from most to all of the molybdenum network in exposure at 1800°C for 5000 h. This behavior was inferior to the two PMC fuel forms. Comparative compatibility of the SSC was the same as the PMC. Behavior of the current reference PMC fuel form was equivalent to the BCL-PMC, with enhanced stability exhibited when exposed in TZM or Ta-10W inner containers. Exposures at 1500°C for 500 and 5000 h, 1800°C for 1000 and 5000 h, and 2000°C for 1000 h in double container semi-system test configurations resulted in increased fuel form degradation with increasing temperature and time. However, TZM liners with TZM, Mo-46Re, and W-25Re structural members provided excellent containment at all temperatures. (auth)

7869 (MLM-2099) MOUND LABORATORY ISOTOPIC POWER FUELS PROGRAMS: JULY–SEPTEMBER 1973. (Mound Lab., Miamisburg, Ohio (USA)). 21 Nov 1973. Contract AT(33-1)-Gen-53. 40p. Dep. NTIS $4.00.

Progress in the isotopes fuel program during July to Oct 1973 is reported. Preparation and fuel characterization studies of ^{238}Pu fuels continued. The effect of lower pressing temperatures on pressed plutonium oxide (PPO) spheres was evaluated. Plutonium-238 dioxide feed material that was sintered to a maximum of only 900°C was pressed under otherwise normal conditions into a Multihundred Watt (MHW) type fuel sphere. This pressing resulted in a sphere with near-perfect surface texture. The surface was bright and totally free of any visible cracks. However, upon subjection to the normal 1500°C vacuum heat treatment, the sphere cracked severely. Metallographic examination of selected areas of MHW PPO spheres showed that the spheres were not uniform in microstructure. They possessed nonuniform grain size and porosity distribution. Spheres exposed to high-temperature heat treatments also were nonuniform in microstructure. Calculations were performed to determine the stresses that appear in MHW PPO spheres due to temperature gradients. Thermal shock analyses were also performed. The data obtained as a result of these analyses were used in establishing a controlled heating and cooling cycle for the 1500°C, 1-h outgassing process for development and production spheres. In order to evaluate the performance of a quadrupole mass spectrometer capable of evolved gas analysis of PuO_2 up to 1850°C, a residual gas analysis system utilizing a quadrupole mass spectrometer was installed in an alpha glovebox. The installation and cold check-out of the system are essentially completed. Several nonradioactive samples and standards were analyzed to establish the sensitivity and to calibrate the instrument. Samples of iridium hemishells were examined using the quadrupole mass spectrometer and both transmission and scanning electron microscopy. These examinations were performed in an attempt to better identify the nature of the iridium being used in the Multihundred Watt Heat Source Program. (LCL)

7870 (ORNL-4785) HELIUM RELEASE FROM $^{244}Cm_2O_3$. Angelini, P.; McHenry, R. E. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 16p. Dep. NTIS $4.00.

The release of helium from hot-pressed pellets and sol-gel microspheres of $^{244}Cm_2O_3$ was investigated under isothermal steady-state release at 900 to 1700°C. The release of helium from hot-pressed pellets of coprecipitated 75 mole % $^{244}Cm_2O_3$–25 mole % Gd_2O_3 and 46 mole % $^{244}Cm_2O_3$–54 mole % Gd_2O_3 was also investigated at 1300 to 1700°C. Release characteristics could be approximately described by diffusion models. Rationally consistent mechanisms are postulated for the release of helium from $^{244}Cm_2O_3$. (auth)

7871 (SAN-858-50) RADIOISOTOPE HEAT SOURCE DEVELOPMENT FOR AN ARTIFICIAL HEART DEVICE. Phase I. Final Report. Lurie, H. (TRW Systems Group, Redondo Beach, Calif. (USA)). Apr 1973. Contract AT(04-3)-858. 244p. Dep. NTIS $14.25.

Detailed parametric analyses of vented radioisotope heat sources were performed to arrive at a design optimized in weight, volume, and safety. The top rated system was a single-layer Hafnalloy heat source. Due to limited mechanical property, compatibility, and heat source test data available for this material, however, the three-layer Pt-20Rh/T-111/Pt-20Rh design, which rated next highest, was selected as the baseline design. The heat source, 0.984 in. in dia by 1.795 in. long, contains 33.1 watts of electro-refined PuO_2 and weighs 0.62 lb. A nonselective pressure relief device/capillary assembly is connected between the noble metal liner and clad to allow venting of the helium gas generated by fuel decay and also to allow decay of the generated radon-220 gas to allowable levels. Pressure relief device tests verified its flow stability and fuel fines retention capability. Radon attenuation tests indicated a 0.001-in. I.D. capillary is required to reduce the radon levels to acceptable levels if it is assumed that all generated radon is released from the fuel. Safety design verification tests, including granite impact, bullet impact, crushing, fire, and post-accident oxidation, indicated both the baseline and Hafnalloy designs to survive all accident environments except one by containing the fuel simulant in at least one totally integral capsule component. Neither design was capable of containing the fuel simulant under a 2000 ft-lb 30-06 rifle bullet impact. Further studies in this area as related to heat source design are required. (auth)

Radiation Sources

Refer also to abstracts 7790 and 8068.

7872 DEVELOPMENT AND APPLICATION OF MOCK IODINE-131. Istvan, P.; Ferenc, M. pp 119-134 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

A 12:1 mixture of ^{133}Ba and ^{137}Cs is being used to simulate the gamma ray spectrum of iodine-131 an isotope of great significance in medical work. Studies have been made of the effect of filters and the utilization of the mocks in comparative measurements and with phantoms. (auth)

7873 TECHNICAL AND SAFETY PROBLEMS OF RELOADING STRONG γ SOURCES. Jozsef, H.; Jozsef, M.; Vilmos, S.; Zoltan, S. pp 309-321 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

The installation of high-efficiency irradiation plants in Hungary necessitated measures to ensure the safe reloading of large imported ^{60}Co sources. Techniques of dry and wet (under water shield) reloading have been worked out. A special method was developed for teletherapeutical cobalt irradiation units. (auth)

7874 IMPROVED QUALITY OF SOME SOURCES OF LINEARLY POLARIZED PHOTONS. Dixon, W. R. (National Research Council of Canada, Ottawa); Storey, R. S.; Ljubicic, A.; Jones, R. T.; Logan, B. A. Nucl. Instrum. Methods; 113: No. 1, 149-150(1973).

The qualities of the reactions $^{24}Mg(p,p'\gamma)^{24}Mg$ and ^{56}Fe $(p,p'\gamma)$ ^{56}Fe, when used as sources of linearly polarized photons, have been investigated. The advantage of protons of energies higher than those commonly used is pointed out. (auth)

Design and Fabrication

Refer also to abstract 7956.

7875 MULTIPLE PASS FLUID IRRADIATOR WITH SEDIMENT REMOVAL CAPABILITY. Graybeal, C. R. US Patent 3,767,918. 23 Oct 1973. Filed date 21 Sep 1970. 6p.

The construction of a fluent material irradiator is described. Exemplary of the many uses presently contemplated for the irradiator are the treatment of polluted fluent material, such as sewage; the treatment of germ-laden air to purify the same; the structural modification of atomic structures of materials undergoing treatment, such as metal dusts; the polymerization or partial polymerization of liquid monomers; and as a sterilizing process step in the reprocessing of chicken manure. (Official Gazette)

7876 ALPHA SOURCES FOR CHANNELING EXPERIMENTS. Kirschner, H. (Univ., Goettingen, Ger.). Nucl. Instrum. Methods; 112: No. 3, 555-557(1973). (In German).

A method for producing strong or weak ^{228}Th α-sources for channeling experiments is described. (auth)

7877 NEW DEVICE FOR THE CALIBRATION OF DOSIMETERS AND DOSE RATE METERS. Istvan, P.; Istvan, K. pp 173-186 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

A new calibrating device based on a 100 mCi ^{90}Sr source has been developed for checks in the range from 10^{-3} to 10^{5} R/h. Although the calibration method is not an absolute one, it is more satisfactory than electrical self-calibration. Parameters of dosimeters used at the Institute of Isotopes of the Hungarian Academy of Sciences are given. (auth)

7878 ADVANCES IN THE PRODUCTION OF SEALED RADIATION SOURCES. Ferenc, M.; Laszlo, R. pp 255-268 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

Development in the production and manufacturing technology of radiation sources in Hungary since 1960 are reviewed in discussing the production methods of up-to-date sources. Particular emphasis is placed on the superiority of arc welding under protective-argon atmosphere among the methods of source sealing. Standards required of sources, methods of quality and production testing and the devices used for this purpose are discussed. (auth)

Industrial Uses

Refer also to abstracts 7825, 7913, 7926, and 8044.

7879 (EURISOTOP-73) POSSIBILITIES OF IMPROVING TEXTILES BY RADIOFINISHING. Proceedings of the Work Session, Brussels, December 13, 1971. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). 1973. 82p. (In French). (CONF-711231-).

The inflammability of textile fibers and the technology of industrial fireproofing are discussed. The use of radiation grafting as a means of fireproofing textiles is examined. (TFD)

7880 (EURISOTOP-86) SCIENTIFIC AND TECHNOLOGICAL ASPECTS OF THE RADIOPASTEURIZATION OF EGG PRODUCTS. Etienne, J. C.; Biltiau, J.; Rombaux, J. P. (Commission of the European Communities, Brussels (Belgium). Bureau Eurisotop). Nov 1973. 116p. (In French). Dep. NTIS (U. S. Sales Only) $8.00.

A bibliographic review is presented of the scientific and technological problems in the thermal pasteurization of egg products and the possible advantages of the substitution of radiopasteurization. Current procedures of pasteurization are described. Conditioning of the egg products by congealing or dehydration prior to storage is discussed. A comparative examination is made of the physico-chemical properties of treated egg products and of the organoleptic qualities of the finished product. The present status of radiopasteurization, the problems to be solved, and the economic aspects are discussed. (JSR)

7881 (INIS-mf-455) TOXICITY AND HEALTH PHYSICS ASPECTS OF IRRADIATED FOOD. Lafontaine, A. (Institut Belge de l'Alimentation et de la Nutrition "Iban", Brussels). 1972. 10p. (In French). INIS.

Various aspects of the toxicity and wholesomeness of irradiated foods are considered. Precautions are taken that irradiated food can be consumed for a long period of time without risk. In order to insure the absence of induced radioactivity it is recommended that ^{60}Co gamma, ^{137}Cs gamma, or electrons of less than 10 MeV be used. If the dose is less than one Megarad, the risk to the nutritional value does not appear to exceed that of heat treatment. The absence of toxic, carcinogenic, teratogenic, and mutagenic properties is assured. Due to a lack of convincing experiments, the World Health Organization has accepted only three foods, i.e., cereals, potatoes, and onions, irradiated with weak doses of 0.01 to 0.075 Megarad. This acceptance is provisory only; it is estimated that the data are insufficient to establish complete absence of risk; it will be necessary to obtain supplementary proof in a maximum period of five years. (HLW)

7882 RADIOACTIVE TRACER METHOD AND APPARATUS FOR BOREHOLES. Greaney, J. E. (to General Nuclear, Inc.). US Patent 3,766,388. 16 Oct 1973. Filed Date 4 Jun 1971. 8p.

Improved well-logging apparatus is provided which employs a long-lived radioactive material for tracing the flow path of fluid traveling in a subterranean borehole. The radioactive source is a porous capsule containing a long-lived parent isotope in a granule form incapable of permeating the wall of the capsule, but producing a non-granulated daughter product having a short half-life. A flush of solvent is passed through the capsule and into the borehole to dissolve away the daughter product and to redeposit it in the borehole. Hence, the long-lived parent isotope is kept from contaminating the borehole, and only the short-lived daughter product is used which disappears in a relatively short interval. (Official Gazette)

7883 MEASUREMENT OF CONSUMPTION OF LUBRICATING OIL IN ENGINE BY MEANS OF ^{35}S TRACER. In Transient State of Operation. Kawamoto, J. I.; Yamamoto, M. (Toyota Central Research and Development Lab., Inc., Nagoya, Japan). Radioisotopes (Tokyo); 22: No. 7, 338-343(Jul 1973). (In Japanese).

The authors have previously reported a tracer method for measuring engine oil consumption using beaded plastic scintillation detector and oleic acid sulfide containing ^{35}S. Measurement of engine oil consumption has usually been made under constant engine operating condition. The data thus obtained, however, cannot be said to give a real state of oil consumption of the engine which is frequently accelerated and decelerated in actual driving. It was required to develop a bench test which made it possible to measure oil consumption in transient engine operation. To meet this requirement, response time of the measuring apparatus should be shorter than 10 seconds. The apparatus, previously reported, had a longer response time, because of longer duration needed for homogenization of reacted absorbing solution. A measuring system with quick response was developed. The exhaust gas from an engine was completely burned in an oxidizing furnace, and brought into contact with aqueous H_2O_2 solution in a reaction tube, where $^{35}SO_2$ was converted into $H_2{}^{35}SO_4$ solution. The $H_2{}^{35}SO_4$ solution was constantly pumped into a beaded plastic scintillation detector and its radioactivity was continuously measured. Because about 2.6 cc of H_2O_2 solution was enough to capture all the SO_2 involved in a liter of the exhaust sample gas, it was possible to obtain a solution with higher specific radioactivity than by conventional absorbing tube. When the flow rate of H_2O_2 solution, specific activity of engine oil and sampling speed of exhaust gas were kept constant, the oil consumption rate was changed in proportion to the product of specific activity of absorbing solution and exhaust gas speed of the engine. The oil consumption rate was observed on the spot by processing these data on a computer. One of the findings from this measurement was that oil consumption rate increased immediately after acceleration. (auth)

7884 CAPRI: RADIOCHEMICAL TREATMENTS. Outlook for 1983. Laizier, J. (CEN de Saclay, Gif-sur-Yvette, France). Ind. At. Spatiales; 17: No. 3, 57-60(May 1973). (In French).

CAPRI is a center enabling industry to benefit from radiochemical processes or products. The sectors involved are the treatment of surfaces and textiles, the processing of thermosensitive materials, and the development of polymers. (FR)

7885 SPACECRAFT HEAT SHIELD TESTING METHOD. Delacy, T. J. (to General Dynamics Corp.). US Patent 3,769,511. 30 Oct 1973. Filed date 12 Oct 1970. 6p.

A process for measuring the service life of heat shields on reentry spacecraft after each flight is disclosed. A low electron-energy level, beta emitting, isotope, having a reasonably long half-life, preferably promethium-147, is uniformly dispersed throughout a refractory heat shield coating. The beta particle emission level at the coating surface is measured to provide a base reading. After each space flight, the beta emission level at the coating surface is again measured, such as by autoradiography or with a Geiger–Müller counter. Erosion, abrasive wear, spalling or other damage is detected and measured to determine whether additional flights can be made without re-coating. (Official Gazette)

7886 METHOD FOR MEASURING THE CONCENTRATION OF SAND IN A FLUID STREAM. Lewis, D. R. (to Shell Oil Co.). US Patent 3,767,916. 23 Oct 1973. Filed date 20 May 1971. 6p.

The grain concentration of a stream of grain-containing fluid is measured by positioning an abradable radioactive material in the stream, measuring the stream velocity and the rate of abrasion-induced reduction in radiation emission, and determining the grain concentration from that of a stream of known composition that causes the measured rate of radiation emission reduction while contacting an equivalent material at the measured velocity. (Official Gazette)

7887 APPARATUS FOR RADIATION POLYMERIZATION. Platz, G. M.; Greenberg, D. H. (to National Distillers and Chemical Corp.). US Patent 3,759,811. 18 Sep 1973. Filed date is Jan 1970. 12p.

An elongated radioactive source of gamma radiation is used in initiating polymerization in a polymerization reactor. The elongated source rod is axially movable within the reactor so that its end terminates at any desired location within the reactor, thereby adjusting the effective volume within the reactor which will have polymerization processes initiated. This in turn adjusts the production rate of the reactor. A servo system is connected to drive the radioactive source rod to maintain a constant production rate. The radioactive rod may be divided into two or more parallel rods which are independently movable in order to provide any desired profile for the intensity of the radiation source. (Official Gazette)

7888 FORECAST ON TECHNOLOGICAL PROGRESS IN RADIOISOTOPE AND RADIATION UTILIZATION. At. Jap.; 16: No. 11, 20-23(Nov 1972).

Predictions in the utilization technology of radioisotopes and radiation in Japan, made by the Science and Technology Agency in October 1972, are summarized based on the results of questionnaires sent to about 1,000 experts on radiation. By the 1980s, radioisotopes and radiation will find wider application in medicine, agriculture, measurement, and instrumentation. Half of the radiation sources required will be produced domestically by that time. The following matters are discussed: manufacture of the radioisotopes, utilization in agriculture, industrial utilization, medical applications, prevention of radiation hazards and disposal of radioactive wastes, and the development of new technology. (JA)

7889 USE OF CERTAIN ACTIVABLE SUBSTANCES AS TRACERS. Chapelet-Letourneux, G.; Crambes, M.; Kervennal, J.; Rassat, A. (to Entreprise de Recherches et d'Activites Petrolieres). French Patent 2,145,382. 12 Jul 1971. 5p. (In French).

The use of certain activable substances as tracers was studied: dipivaloylmethane chelates (particularly uranyl or indium dipivaloylmethanates). These substances are used to detect leaks in vessels of any shape. (FR)

7890 METHOD OF IRRADIATION. Aine, N.; Kondo, T. (to Sekisui Chemical Co. Ltd.). Japanese Patent 1973-1293. 21 Nov 1966. 3p. (In Japanese).

An irradiation device for use in polymerization processes is described. The device has a rotary shaft with screw-shaped agitating vanes for moving the material through the container. The radiation source is contained in the rotary shaft or agitating vanes. (TFD)

7891 DEVELOPMENT OF HIGH-EFFICIENCY IRRADIATION PLANTS. Jozsef, H.; Vilmos, S.; Zoltan, F. pp 269-288 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

Starting from a simple irradiation can, the Institute successively developed a 1500 Ci ^{60}Co experimental food irradiation plant, an 80,000 Ci ^{60}Co experimental plant and, finally, a 55,000 ^{60}Co plant for the food industry. During construction and operation solutions had to be found for many problems connected with radiation protection, dosimetry, source reloading, calculation methods, and the construction of mechanical devices and an electrical locking system. (auth)

7892 RADIOACTIVE TRACER PULSE METHOD OF EVALUATING FRACTURING OF UNDERGROUND OIL SHALE FORMATIONS. Lorenz, P. B. Report of Investigations 7791. Washington; Dept. of the Interior (1973). vp.

A feasibility study on the use of tracer pulses to assess the degree of fracturing in an underground formation is presented. The study consisted of the following three phases: (1) a laboratory study on sand packs and open tubes, which developed a correlation between dispersion of the pulse and size of the flow channels; (2) a test on a retort, 11 ft in dia and 45 ft high, packed with shale rubble. Void volume was measured, but evaluation of channel size was not possible because of interference from the space unoccupied by the matrix; (3) a field test on an explosively fractured shale formation. Pressure, flow, and transit time led to qualitative estimates of fracture pattern, but quantitative detection of dispersion in the formation was overwhelmed by dispersion effects in the well. (auth)

LIFE SCIENCES

7893 (AECL-4610) BIOLOGY AND HEALTH PHYSICS DIVISION PROGRESS REPORT, APRIL 1–JUNE 30, 1973. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1973. 71p. (PR-B-98). Dep. NTIS (U. S. Sales Only) $5.75. AECL $1.50.

Research progress is reported for the Biology and Health Physics Division of the Chalk River Nuclear Laboratories. Activities in the biology, population research, environmental research, and health physics branches are summarized. (ERB)

Radiation Effects on Biochemicals

Refer also to abstract 7925.

7894 EFFECT OF RADIOIODATION ON THE BIOLOGICAL AND IMMUNOLOGICAL PROPERTIES OF CERTAIN PROTEINS. Jothy, S.; Ruffie, A.; Nouyrit, J. M.; Blanquet, P. (Institut National de la Sante et de la Recherche Medicale, Bordeaux). J. Biol. Med. Nucl.; 8: No. 31, 21-25(1973). (In French).

The biological and immunological properties of various proteins (HCG, HLH, synthetic corticotropin, porcine calcitonin, and gamma-globulin) were studied after labeling them with ^{131}I and ^{125}I by the chloramine T method. The HCG and the calcitonin exhibit diminished biological properties. Human lactogenic hormone looses some of its immunological properties. (FR)

7895 INACTIVATION OF DNA POLYMERASE I AND II BY UV IRRADIATION AND ITS ENHANCEMENT BY 5-IODO-2'-DEOXYURIDINE TRIPHOSPHATE. Ku, K. Y. V. New Haven; Yale Univ. (1973). 155p. University Microfilms Order No. 73-26,665.

Thesis (Ph.D.).

Incorporation of 5-iodo-2'-deoxyuridine (IdUrd) into DNA of mammalian cells, bacteria, and viruses has been shown to enhance the lethal effect of uv irradiation. The rate of uv inactivation of enzymes concerned with the biosynthesis of DNA-thymine is enhanced when irradiation is performed in the presence of an appropriate iodinated substrate. Thus the rate of uv inactivation of thymidine kinase has been reported to be markedly increased when the enzyme is in complex formation with IdUrd, a metabolic analog of the normal substrate thymidine. Such findings thus initiated studies concerned with the possible sensitization of DNA polymerase to inactivation by uv radiation when the appropriate iodinated substrate is present. When highly purified DNA polymerase I from wild type E. coli and partially purified DNA polymerase II from E. coli mutant strain P3478 Pol A1 were subjected to uv irradiation at a rate of 179 ergs/mm^2/sec, exponential loss of enzymatic activity was observed with both polymerases; and the rate of inactivation of DNA polymerase II was three times as fast as that for DNA polymerase I. The optimum requirements of DNA polymerase I and II for magnesium ion, activated DNA template-primer and pH were identical before and after uv irradiation. These observations are compatible with an all-or-none phenomenon. The four natural deoxyribonucleoside triphosphates (dTTP, dCTP, dATP and dGTP) had little or no effect on the inactivation of either polymerase by uv irradiation; however, IdUTP, a metabolic analog of dTTP enhanced more markedly the uv inactivation of DNA polymerase II relative to DNA polymerase I. This enhancement effect was dependent on the concentration of IdUTP and was saturable. These findings indicate that IdUTP exerted a specific effect that probably is related to the substrate function of IdUTP at the active center of the enzyme. Inclusion of magnesium ion or DNA in the irradiation mixture caused an additional increase in the rate of uv inactivation of both enzymes when in the presence but not absence of IdUTP. These observations were attributed to induced conformational changes of the enzymes by magnesium or by DNA. Thus two closely related enzymes DNA polymerase I and II were shown to respond with marked differences to uv irradiation, particularly in the presence of the photolabile substrate, IdUTP. The possible use of such photochemical reactions to label or to identify differences between similar enzymes are discussed. (Diss. Abstr. Int., B)

7896 COMPARATIVE STUDY OF MODIFICATIONS PRODUCED BY X RAYS IN BOVINE SERUM PROTEINS. Azanza, J. L.; Ducastaing, A.; Raymond, J.; Creac'h, P. Compt. Rend. Soc. Biol.; 166: No. 12, 1657-1664(1972). (In French).

Serum albumin and γ globulin appear to be more radiosensitive than α and β globulins. Small irradiation doses are sufficient to chemically modify certain sites in these proteins without producing very serious modifications in the secondary and tertiary structures. Such modifications contribute to the understanding of the differences in the physiological, and in particular antigen behavior of proteins in the original and denatured forms. (FR)

7897 EFFECT OF CIS-PLATINUM(II)DIAMMINODICHLORIDE ON WILD TYPE AND DEOXYRIBONUCLEIC ACID REPAIR-DEFICIENT MUTANTS OF ESCHERICHIA COLI. Beck, D. J.; Brubaker, R. R. (Michigan State Univ., East Lansing). J. Bacteriol.; 116: No. 3, 1247-1252(Dec 1973).

The anti-tumor drug cis-platinum(II)diamminodichloride (PDD) induced extensive filamentation in wild-type Escherichia coli and in mutants lacking certain deoxyribonucleic acid (DNA) repair functions (uvrA, recB, recC, and polA); viability of repair-deficient mutants treated with PDD was significantly less than that of wild-type cells. PDD was highly toxic to lex1, lex1 uvrA6(where its effect was cumulative), and recA13 mutants, all of which were killed without formation of filaments. ^3H-thymine incorporated into DNA of cells subsequently treated with PDD became trichloroacetic acid-soluble at rates similar to those observed after exposure to comparable doses of ultraviolet light (uv) or mitomycin C. PDD, like uv, induced extensive degradation of DNA in recA organisms. After a 30-min lag, PDD inhibited significantly the synthesis of DNA but not of ribonucleic acid or protein in E. coli. However, the relative differences between rates of DNA synthesis observed in PDD-treated and control cells decreased substantially when the duration of pulses (^3H-thymine) was prolonged from 2 to 5 min. These observations suggest that PDD-induced damage to DNA is reversible, possibly by defined mechanisms of excision and recombination repair. (auth)

7898 EFFECT OF RIFAMPIN ON THE STRUCTURE AND MEMBRANE ATTACHMENT OF THE NUCLEOID OF ESCHERICHIA COLI. Dworsky, P.; Schaechter, M. (Tufts Univ., Boston). J. Bacteriol.; 116: No. 3, 1364-1374(Dec 1973).

Deoxyribonucleic acid (DNA) of Escherichia coli was found to be attached to the cell membrane at about 20 points. This was determined by fractionation of x-irradiated cells with the M band (magnesium-Sarkosyl crystals) technique. The number of attachment points was computed from the relationship between the amount of DNA in M bands and the number of double-strand breaks introduced by the x-ray treatment. The number of attachment points was decreased fourfold by treatment of cells with rifampin. This effect was apparently due to the action of the drug on ribonucleic acid (RNA) polymerase since the drug did not affect a mutant whose RNA polymerase is resistant to rifampin. This suggests that there may be two classes of attachment points of DNA on the membrane, some of which are removed by rifampin treatment and some that are not. Rifampin treatment also resulted in the uncondensing of isolated nucleoids and in an axial appearance of the nucleoids in ultrathin sections. The results suggest that RNA polymerase plays a role, direct or indirect, in maintaining the structure of the bacterial nucleoid and in some of its attachment to the membrane. (auth)

7899 FORMATION OF INTER-STRAND CROSS-LINKINGS ON DNA OF GUINEA PIG SKIN AFTER APPLICATION OF PSORALEN AND IRRADIATION AT 365 nm. Dall'aqua, F.; Marciani, S.; Vedaldi, D.; Rodighiero, G. (Univ., Padua). FEBS (Fed. Eur. Biochem. Soc.) Lett.; 27: No. 2, 192-194(1 Nov 1972).

The results indicate that psoralen not only is able to photobind to DNA in guinea pig skin but also forms cross-linkings. Probably cross-linking formation plays a role in determining the effects that follow irradiation of the skin in the presence of furocoumarins. (auth)

7900 DNA DEGRADATION AND EXCISION REPAIR IN γ-IRRADIATED CHINESE HAMSTER OVARY CELLS. Mattern, M. R.; Hariharan, P. V.; Dunlap, B. E.; Cerutti, P. A. (Univ. of Florida, Gainesville). Nature (London) New Biol.; 245: No. 147, 230-232(24 Oct 1973).

Gamma radiation from ^{137}Cs induced limited DNA degradation in Chinese hamster ovary cells. At 20°C, in the dose range of 5 to 25 Krad, the accumulation of intracellular and extracellular acid-soluble thymine label ceased 30 to 40 min after termination of irradiation. A linear dose response was obtained for the total amount of label accumulated at this time, and on average 0.07 of thymine label per Krad remained acid soluble. The intracellular and extracellular acid soluble radioactivity was analyzed as a function of postirradiation incubation (up to 100 min) by ion-exchange chromatography. It is suggested that radiation-induced DNA degradation starts during irradiation, leading to the formation of mononucleotides. Thymidine monophosphate is then rapidly dephosphorylated to the nucleoside, or to a smaller extent, phosphorylated to thymidine-5'-triphosphate (TTP). While thymidine

accumulates in the culture medium and is further degraded to thymine, the phosphorylated derivatives are retained inside the cell. The removal of radiation-damage thymine from the DNA during postirradiation incubation was demonstrated at a dose of 25 Krad, using methyl-^{14}C-thymidine added as a marker to the intra- and extra-cellular acid-soluble fraction before chromatography. The results indicated that γ radiation damaged thymine residues were removed from the DNA within 60 min postirradiation incubation. (UK)

7901 PERVICHNYE RADIOBIOLOGICHESKIE PROTSESSY. (Primary Radiobiological Processes). Amiragova, M. I. (ed.). Moscow; Atomizdat (1973). 336p.

Transformation of the energy of ionizing radiation in biological media and the action of radiation on the four classes of biologically important compounds (phospholipids and their components, amino acids and proteins, nucleic acids and their components and porphyrin compounds) are examined. The role played by disturbances in these substances in radiation damage to cells and organisms is discussed. The molecular bases of radiation pathology, recovery, and antiradiation protection of the organism are considered. This second edition has been considerably revised. Experimental material is supplemented by new developments in radiochemical conversions of carbon-containing acids, phospholipids, and carbohydrates. The book is designed for specialists in molecular and general radiobiology, radiation chemistry, and radiation genetics as well as physics and biology and other scientific specialists interested in the action of ionizing radiation on living organisms. (tr-auth)

7902 FUNDAMENTALS OF INTERACTION OF IONIZING RADIATIONS WITH CHEMICAL, BIOCHEMICAL, AND PHARMACEUTICAL SYSTEMS. Schulman, S. G. J. Pharm. Sci.; 62: No. 11, 1745-1757(Nov 1973).

A literature review is presented of the chemical and biological effects of ionizing radiations with special reference to the pharmaceutical sciences. A review of the theoretical principles of interactions of high energy radiations with matter is presented with regard to three stages of the process: physical, physicochemical, and chemical. In a discussion of the irradiation of gases the ionization of gas molecules and modes of reaction of free positive ions in gas media are considered. The irradiation of liquids is discussed with regard to water, aqueous solutions, and organic liquids. The irradiation of solids is reviewed with regard to metallic crystals, valence crystals, ionic crystals, and molecular crystals. A review of chemical protection from ionizing radiations considers energy and charge transfer, scavenging intermediates, and complex formation. Effects of ionizing radiations on biological molecules are reviewed with regard to carbohydrates; amino acids and peptides; proteins and enzymes; respiratory proteins, vitamins, and coenzymes; and nucleic acids. Studies on pharmaceutical systems are concerned with radioprotective drugs such as sulfhydryl compounds, estrogens, and bacterial lipopolysaccharides. (HLW)

7903 EFFECTS OF IRRADIATION ON PROTEIN. Changes In Amino Acid Composition, Optical Rotation, and Infrared and Ultraviolet Spectra of Amino Acids and Peptides Produced by Irradiation. Nisizawa, M. (Keio Univ., Tokyo). Keio Igaku; 50: No. 5, 429-435(Sep 1973). (In Japanese).

The solid amino acid (L-tyrosine) and peptide (glycyltyrosine) were irradiated (10^3–10^7 rad) by ^{60}Co gamma rays and the effects on the molecules were studied by amino acidimetry, polarimetry, and infrared and ultraviolet spectrometry. Amino acid composition of peptide was decreased depending on the irradiation doses, while ammonia increased depending on the irradiation doses. Changes in amino acid composition with irradiation may be caused by slackening or rupture of the bonds of the peptide molecule. The specific rotation of irradiated amino acid and peptide decreased in relation to irradiation dose. Changes in optical rotation with irradiation may be caused by changing of the radicals in the circumference of asymmetric carbon atoms. The relative intensity of the carboxy and hydroxy phenyl group in the infrared and ultraviolet spectra of irradiated amino acids and peptides decreased in relation to irradiation dose. Changes in infrared and ultraviolet spectra with irradiation may be caused by way of destruction of the radicals in amino acid and peptide molecules. (auth)

7904 EFFECTS OF IRRADIATION ON PROTEIN. Changes in Amino Acid Composition and Infrared and Ultraviolet Spectra of Protein Produced by Irradiation. Nisizawa, M. (Keio Univ., Tokyo). Keio Igaku; 50: No. 5, 423-427(Sep 1973). (In Japanese).

Solid protein (albumin) was irradiated (10^3 to 10^7 rad) by ^{60}Co gamma rays and the effects on the protein molecule were studied by amino acidimetry, and infrared and ultraviolet spectrometry. Amino acid composition decreased depending on the irradiation. Changes in amino acid composition with irradiation may be caused by slackening or rupture of the bonds of the protein molecule. The contents of the carboxyl group estimated by infrared spectra decreased depending on the irradiation dose. Changes in infrared spectra with irradiation may be caused by way of destruction of the radicals in the protein molecule. The contents of the aromatic group estimated by the ultraviolet spectra decreased in relation to irradiation dose. It is considered that the changes in ultraviolet spectra with irradiation may be caused by destruction of the radical in the protein molecule. (auth)

Radiation Effects on Cells

Refer also to abstract 7947.

7905 (CONF-730952-6) DNA DAMAGE IN MAMMALIAN CELLS AND ITS RELEVANCE TO LETHALITY. Elkind, M. M.; Ben-Hur, E. (Argonne National Lab., Ill. (USA)). 1973. 40p. Dep. NTIS $4.00.

From fourth symposium on microdosimetry; Pallanza, Italy (24 Sep 1973).

Cell killing (loss of proliferative capacity) is a principal end point in all radiation effects contingent upon cell viability. DNA, the molecular carrier of the genetic inheritance, affects the affairs of a cell because the properties and characteristics of a cell are dictated by the DNA → RNA → protein axis of information storage, flow, and expression. Thus, the mutagenic and chromosome-breaking properties of radiation, the biological amplification available to a lesion in DNA, and the fact that DNA molecularly constitutes a very large radiation target, all make DNA the principal target relative to many radiation effects. An indirect approach may be useful in studies of the sensitive targets in a mammalian cell. This stems from the fact that to kill cells with low LET radiation, sublethal damage must be accumulated and cells can repair this damage. Thus, focussing on DNA, and repair processes in DNA, while indirect, is supported in the instance of cell killing by extensive experimental evidence. The status of damage registered directly in DNA may be assessed by examining changes in the sedimentation of DNA from irradiated cells. Along with measurements of cell survival, sedimentation data are discussed relative to their bearing on cell killing and their ability to help us understand the organization and replication of DNA in mammalian cells. (CH)

7906 HISTOINCOMPATIBILITY RECOGNITION REACTION BY IRRADIATED OR MITOMYCIN-TREATED PARENTAL CELLS AGAINST HYBRID SPLEEN CELLS PRODUCES HYBRID CELL PROLIFERATION AND ILLUSION OF REACTION OF HYBRID AGAINST PARENT. Kennedy, J. C.; Ekpaha-Mensah, J. A. (Queen's Univ., Kingston, Ont.). J. Immunol.; 111: No. 6, 1639-1652(Dec 1973).

The addition of heavily irradiated or mitomycin-treated spleen cells to cultures containing syngeneic spleen cells and foreign erythrocytes may stimulate to some extent the hemolytic plaque-forming cell responses of these cultures, but the addition of semi-allogeneic irradiated or mitomycin-treated spleen cells may cause much greater stimulation. This semi-allogeneic stimulation is completely reciprocal; the plaque-forming cell responses of F_1 hybrid spleen cell cultures often are stimulated as much after the addition of non-proliferating parental cells as are the responses of parental spleen cell cultures after the addition of non-proliferating F_1 hybrid cells. The possibility that an in vitro manifestation of hybrid resistance might be involved was ruled out. It was found that irradiated or mitomycin-treated cells, although unable to proliferate, were still able to initiate a recognition reaction against histoincompatible cells, releasing in the process a soluble factor that stimulated proliferation of cells of the antibody-forming series. The significance of this finding for one-way mixed lymphocyte reactions is discussed. (auth)

7907 QUANTITATIVE DESCRIPTION OF THE PROCESS OF RADIATION CELL INACTIVATION. I. Basic Assumptions. Lethal Damage Formation. Darsukov, V. S.; Malinovskii, O. V. (Leningrad Inst. of Nuclear Physics). Tsitologiya; 15: No. 9, 1152-1159(Sep 1973). (In Russian).

The dominant lethal effect of ionizing radiation is explained in terms of genome hypothesis, and all quantitative considerations were made taking an asymmetrical chromosome exchange formation as an example. The cytogenetical model permitted to relate the cell radiosensitivity with the yield of primary lesions and with the postirradiation effects. The dose to dependence of the effect (yield of chromosome exchanges) has reflected the stochastics of postirradiation processes, since the number of hits is practically equal in all the cells. Kinetics of primary lesion elimination and of accumulation of chromosome asymmetrical exchanges is considered. The relationship for dose

dependence of the asymmetrical exchange yield appeared to fit well the experimental data. (auth)

7908 RECENT ADVANCES IN RADIOBIOLOGY. Moore, J. (Velindre Hospital, Cardiff, Wales). pp 12-30 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

Information available from in vitro studies on the interaction of radiation with mammalian cells is summarized in relation to applications to radiotherapy of neoplasms. Emphasis is placed on studies of the effects of oxygen on cell radiosensitivity, the effects of LET on RBE, the effects dose fractionation on cell repair processed, and the present state of neutron radiobiology. It is pointed out that human cells in tissue cultures are far removed from their position in the body and that any conclusions drawn from studies on cultured cells must be extremely tentative. In vivo techniques for evaluating radiation effects within organized tissues using mice, rats, rabbits, and other small mammals for determining the radiosensitivity of tumor cells are discussed. It is pointed out that the experimental animals possess quite different cell kinetics from humans which precludes direct extrapolation of results. (CH)

7909 EFFECTIVENESS OF NITROFURAN DERIVATIVES IN SENSITIZING HYPOXIC MAMMALIAN CELLS TO X RAYS. Chapman, J. D.; Reuvers, A. P.; Borsa, J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Brit. J. Radiol.; 46: No. 548, 623-630(Aug 1973).

Various nitrofuran derivatives were tested with Chinese hamster cells growing in vitro to determine their toxicity and radiosensitizing effectiveness. All nitrofurans tested displayed a greater radiosensitizing potential than p-nitroacetophenone for hypoxic cells at concentrations producing no acute toxicity. The most effective compound tested to date is nifuraldezone which at 250 μm in complete medium gives the same extent of radiosensitization (ER ~ 2.85) as oxygen in air-saturated medium. Additional nitroheterocyclic compounds in current clinical usage were also characterized. The chemical and pharmacological properties of the various compounds are discussed in relation to their application in animal tumor studies. High water solubility appears to be an important property for radiosensitizers to be used in animal tumor studies. A positive demonstration of radiosensitization in vivo with nitroheterocyclic drugs will depend upon whether or not a sensitizing concentration of the drugs can be established in the hypoxic cells of a solid animal tumor for the duration of the radiation treatment. (auth)

7910 ^{51}CR-RELEASE ASSAY FOR CELL-MEDIATED CYTOTOXICITY OF HUMAN LEUKEMIA AND LYMPHOID TISSUE-CULTURE CELLS. McCoy, J. L. (Litton Bionetics Research Labs., Bethesda, MD); Herberman, R. B.; Rosenberg, E. B.; Donnelly, F. C.; Levine, P. H.; Alford, C. Nat. Cancer Inst. Monogr.; 37: 59-67(Jun 1973).

Cellular immune reactions to antigens associated with human leukemia were studied by a lymphocyte cytotoxicity assay employing the release of ^{51}chromium (^{51}Cr) from labeled cells of leukemic patients. Low-grade, but significantly positive, cellular cytotoxicity was obtained by the reaction of autologous or allogeneic lymphocytes from patients and from normal adult donors against cells from leukemic patients. Similar reactivity was not found against target cells from normal donors. The results suggest that human leukemia cells possess tumor-associated antigens. Studies to establish immunologic specificity of the positive reactions were technically difficult because of the low reactivity seen and because of difficult logistic problems in repeating the tests. Therefore, to study a variety of parameters that might help establish the specificity of the assay in human systems, human lymphoid cell lines derived from patients with tumors and from normal individuals were used as targets. Many of these (including F-265 and NC37) derived from normal lymphocytes were highly susceptible to lysis by lymphocytes of most normal donors. Agents, such as x-irradiation, actinomycin D, 3'5' cyclic-AMP, and concanavalin A, blocked either completely or partially the cytolytic activity of lymphocytes against F-265 cells. Target cell inhibition tests revealed that addition of graded doses of unlabeled F-265 cells always inhibited ^{51}Cr release from labeled F-265 cells. Similarly, inhibition of cytotoxicity of F-265 was also inhibited by some other cultured lymphoid cells including NC37, but was not inhibited by at least one other cultured lymphoid cell line (Stuck). Normal human lymphocytes stimulated in vitro by phytohemagglutinin were neither effective as inhibitor cells in the F-265 system nor were they directly lysed by lymphocytes of normal individuals. Finally, F-265 cells grown in media containing human sera instead of fetal bovine serum were effective targets in the assay. The results suggest that true cell-mediated immunologic reactions cause the lysis of human tissue-culture lymphoid cells by normal donor lymphocytes. The relevant antigen(s) appears neither to be "blast" associated nor to be related to antigens of fetal bovine serum. Hopefully, this system will be a useful model for defining the specificity of the cellular reactivity against leukemic cells. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 7897, 7898, and 7997.

7911 (CONF-730627-, pp 190-201) COMPUTER TECHNIQUES FOR RADIONUCLIDE TRANSVERSE SECTION TOMOGRAPHY AND QUANTITATIVE SPATIAL (THREE-DIMENSIONAL) IMAGING. Keyes, J. W. Jr.; Simon, W. (Univ. of Rochester, NY). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

Spatial imaging is offered as a term for the process of generating a reconstruction of the three-dimensional structure of an object. Spatial images may be produced either as a gestalt or built up piecemeal. Thus a method producing a set of contiguous, serial transverse section tomograms (TST's) of an object yields, in essence, a spatial image. TST is particularly useful for this type of imaging because individual sections do not contain data from other sections. A number of techniques for image reconstruction are reviewed as to their applicability to TST and in terms of the concept of spatial imaging. The techniques include arithmetical, algebraic, Fourier transform, and convolution methods. Development and application of the Fourier transform method is presented as illustrative of the application of these techniques to radionuclide or emissive spatial imaging. (auth)

7912 (COO-3271-4) GENETIC TRANSFORMATION IN HEMOPHILUS INFLUENZAE. Three Year Comprehensive Report, September 15, 1970–September 14, 1973. (Johns Hopkins Univ., Baltimore, Md. (USA). Dept. of Biochemistry). 1973. 41p. Dep. $4.25.

Progress is reported on the following research projects: purification of the photoreactivating enzyme from bakers yeast; studies on the specific activity, stability, ionic strength, electrophoresis, absorption spectrum, and fluorescence spectrum of the purified enzyme; photorestoration of uv-irradiated Hemophilus influenzae; thymine hydroperoxide mutagenesis; purification of pyrimidine nucleoside phosphorylase from H. influenzae; and specificity of DNA uptake by H. influenzae using tritium and ^{32}P as tracers. (HLW)

7913 (INIS-mf-45) STUDIES ON STORAGE STABILITY OF IRRADIATED WHITE POMFRET (STROMATEUS CINEREUS). Kamat, S. V. (Bombay Univ. (India)). Jan 1970. 160p. INIS.

Thesis.

A brief review is given of the various aspects of biochemical, physico-chemical, and microbiological reactions leading to losses in desirable quality attributes of seafoods and other meat products. The differences in susceptibility of skin and muscle of white pomfrets to radiation-induced oxidative changes are discussed. The efficacy of physical and chemical treatments in minimizing irradiation odors originating from skin was tested with reference to their effect in suppressing the oxidative changes. Pre-irradiation and physical treatments such as blanching, freezing, and anaerobic packaging were examined with a view to minimizing undesirable oxidative changes. The effect of irradiation on pomfret skin packed in brine (0.42 M NaCl) was tested. The nature, mechanism of formation and suppression of oxidative changes, and significance of associated reactions such as carbonyl-amino reactions in reducing the stability of fish are discussed. Sarcoplasmic and fibrillar proteins extracted from fresh pomfret fillets using phosphate buffer and lipids isolated from skin using chloroform–methanol mixture were subjected to radiation doses ranging from 0.1 to 1 Mrad. The type of radiation damage seemed to differ with the protein fractions. Reactions of malonaldehyde with compounds normally present in biological systems like amino acids, proteins etc. leading to yellowing have also been studied. The significance of in vitro studies in elucidating the reactions of precursor molecules and in the determination of the quality of fishery products during storage were discussed. Samples of pomfret fillets were irradiated in Food Package Irradiator IR$_{11}$ (100,000 curies, ^{60}Co γ source) between 8° and 12°C. Biochemical and microbial changes in irradiated fillets were studied and compared with unirradiated samples. The shelf-life of the irradiated samples was found to be extended by 15, 35, and 60 days respectively with 0.1, 0.3 and 0.5 Mrad, respectively. Delay in the onset of yellowing was also studied in the irradiation samples stored under anaerobic conditions. Alterations in storage pattern of irradiated fillets are discussed in the light of microbial and chemical factors influencing storage stability. It is concluded that

irradiation in combination with physical and chemical methods enhances shelf-stability of white pomfret otherwise susceptible to bacterial and oxidative changes. (auth)

7914 (JPRS-60471) SPACE BIOLOGY AND MEDICINE, VOL. 7, No. 5, 1973. Translation of Kosm. Biol. Med.; 7: No. 5, 3-91(1973). 138p. NTIS.

Articles are presented concerning the selection and training of cosmonauts; evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary flights; research aimed at guaranteeing safety on long flights and reliability of the human component of the man-spaceship system; space psychology and physiology; environmental problems and control (spacecraft habitability, effects of radiation and weightlessness, etc.) and telemetry. Separate abstracts were prepared for two articles; an additional 17 articles are included. (JPRS)

For abstracts of individual papers see: 7915 and 7995.

7915 (JPRS-60471, pp 17-24) ANALYSIS OF RESULTS OF INVESTIGATION OF BIOLOGICAL EFFECT OF HEAVY IONS WITH DIFFERENT LINEAR ENERGY LOSSES ON THE BASIS OF A THEORETICAL INACTIVATION MODEL. Guenther, K.; Krasavin, E. A.; Kudryashov, E. I.; Ryzhov, N. I.; Schulz, W. 1973. Translated from Kosm. Biol. Med.; 7: No. 5, 14-20(1973).

It is assumed that cell inactivation is brought about by damage of nuclear DNA, which in turn is induced by ionizations occurring in a volume of a known radius containing DNA. On this basis a theoretical model of cell inactivation for ionizing radiations with different linear energy losses was formulated. Using this model, the relationship between the number of single-strand and double-strand DNA breakages and radiations with linear energy losses differing by a factor of 10^4 is analyzed. Theoretical and experimental results show good agreement. (JPRS)

7916 NUCLEAR APPARATUS OF HYPHOMICROBIUM. Moore, R. L.; Hirsch, P. (Michigan State Univ., East Lansing). J. Bacteriol.; 116: No. 3, 1447-1455(Dec 1973).

The nuclear apparatus of Hyphomicrobium sp. strain B-522 is examined by various microscopy and radiolabeling techniques to determine its behavior during the reproductive cycle of these bacteria. The young, swarmer cell contains a single nucleoid comprised of a deoxyribonucleic acid (DNA) molecule with a molecular weight of 3.1×10^9. After development of the swarmer into a mature mother cell with a hypha and bud, the nucleoid replicates and separates into two daughter nucleoids during the initial stages of bud formation. After further development of the bud, one of the daughter nucleoids in the mother cell is rapidly transferred through the hypha to the bud. Half of the old DNA strands pass to each consecutive generation of daughter cells, but only 43% of the stable ribonucleic acid is transferred. The role that the hypha plays in the developmental cycle of these bacteria is discussed, and a mechanism for nuclear transfer is proposed. (auth)

7917 BIOLOGICAL DAMAGE BY COSMIC RADIATION. Buecker, H. Bild Wiss.; 10: No. 9, 1006-1013(1973). (In German).

The Biostack experiments carried out with Apollo 16 and Apollo 17 are discussed. The object of these tests was to investigate the HZE particles regarding their charge and energy distribution and their effect on biological objects. In order to obtain a clear-cut assignment of radiation damage and HZE particles, the biological objects were firmly connected with nuclear detectors. Nuclear emulsions, silver crystals, and plastic detectors were used. Seven organisms of known and differing sensitivity to conventional ionizing radiation were used as biological objects. Germination and cell growth in single cell organisms and development, growth, and mutations in plant and animal organisms served as criteria of radiation damage. Cosmic radiation HZE particles caused complete destruction, malformation, and retarded development. (GE)

7918 INACTIVATION OF E. COLI MRE 600 RIBOSOMES WITH γ RAYS; ESTABLISHMENT OF THE EXISTENCE OF A GTPASE ACTIVITY INHIBITION FACTOR. Ekert, B.; Vannier, P. (Institut du Radium, Paris). Compt. Rend., Ser. D; 276: No. 26, 3487-3490(25 Jun 1973). (In French).

When E. coli MRE 600 ribosomes, purified by simple washing with phosphate buffer, are irradiated with γ rays, their polyphenylalanine synthesizing power is not reduced as an exponential function of the dose. An inhibitor is rapidly destroyed. At low levels of irradiation, two opposing effects come into play having a stimulating and an activating influence on the ribosome function. The inhibitor appears to be specific to the first GTP hydrolysis reaction. (FR)

7919 INTERACTIONS AMONG GENES CONTROLLING SENSITIVITY TO RADIATION AND ALKYLATION IN YEAST. Brendel, M. (Univ., Frankfurt am Main); Haynes, R. H. Mol. Gen. Genet.; 125: No. 3, 197-216(1973).

In the simple eucaryote Saccharomyces cerevisiae there are at least three phenotypically distinct classes of mutants sensitive to inactivation by radiations and alkylating agents: class I mutants are sensitive to ultraviolet light and nitrogen mustard (HN2); class II mutants are sensitive to x rays and methyl methanesulphonate (MMS); and class III mutants are sensitive to all four of these agents. Doubly mutant strains of types (I,I), (I,II), (I,III), and (II,III), were constructed and their sensitivity to uv, x rays, HN2, and MMS was measured in order to characterize the interactions of the various mutant gene pairs. Class (I,III) double mutants proved to be supersensitive to uv and HN2 and class (II,III) double mutants proved to be supersensitivie to x rays and MMS. All other double mutants showed little or no enhancement of sensitivity over their most sensitive single mutant parents. Mutants of class I are known to be defective in excision repair and our results are consistent with the idea that there exist at least two additional pathways for dark repair in yeast, one capable of repairing x ray and MMS damage to DNA, and another, possibly analogous to post-replication repair in bacteria, that competes with the other two for damaged regions in DNA. (auth)

7920 ANALYSIS OF RESULTS OF STUDYING THE BIOLOGICAL EFFECT OF HEAVY IONS WITH DIFFERENT LINEAR ENERGY TRANSFER ON THE BASIS OF THE THEORETICAL MODEL OF INACTIVATION (INTERPRETATION OF E. COLI EXPERIMENTS). Guenther, K.; Krasavin, E. A.; Kudryashov, E. I.; Ryzhov, N. I.; Shultz, W. Kosm. Biol. Med.; 7: No. 6, 3-8(1973). (In Russian).

The data obtained from experimental irradiation of E. coli with heavy ions of different LET, protons, and gamma rays are analyzed from the point of view of the theoretical model of cell inactivation described in a previous communication. It is indicated that with the use of the model it is possible to determine relative biological effectiveness of any radiation, including mixed types and modified by various factors when limited experimental data are available. (auth)

7921 UNIFORMITY OF RADIATION-INDUCED MUTATION RATES AMONG DIFFERENT SPECIES. Abrahamson, S. (Univ. of Wisconsin, Madison); Bender, M. A.; Conger, A. D.; Wolff, S. Nature (London); 245: No. 5426, 460-462(26 Oct 1973).

It is known that the mean lethal dose for survival of irradiated single cells is related to the nuclear DNA content. A re-examination of the data for radiation induced forward mutation rates was made for organisms as different as bacteria, fungi, higher plants, insects, and mammals for which the amounts of DNA per nucleus was known. The mutation rates per locus per rad for the species examined are shown tabulated, and vary over three orders of magnitude. When these rates are adjusted, however, for the amount of DNA per nucleus, and thus normalized to a common biological baseline, they are all essentially the same, varying only by a factor of three instead of 1000. This consistency in normalized mutation rates in such a wide variety of organisms strongly suggests that extrapolation directly from experimental organisms to man can be done with confidence. (UK)

7922 INFLUENCE OF COSMOS 368 SPACE FLIGHT CONDITIONS ON RADIATION EFFECTS IN YEASTS, HYDROGEN BACTERIA, AND SEEDS OF LETTUCE AND PEA. Grigorev, Yu. G.; Benevolenskii, V. P.; Druzhinin, Yu. P.; Shidarov, Yu. I.; Korogodin, V. I.; Nevzgodina, L. V.; Miller, A. T.; Tsarapkin, L. S. (Inst. of Medical and Biological Problems, Moscow). pp 113-118 of Life Sciences and Space Research X. Vishniac, W. (ed.). Berlin; Akademie-Verlag (1972).

From 14th COSPAR meeting on life sciences and space research X; Seattle, Washington, USA (17 Jun 1971). See CONF-710615-.

Radiobiological studies were carried out on board the Cosmos 368 satellite, launched on 8 October 1970 and returning to earth on 14 October 1970. Yeast diploid cells Saccharomyces ellipsoides, Megri strain 139-B, haploid cells Zygosaccharomyces Baili, hydrogen bacteria Hydrogenomonas eutropha, strain Z-1, Berlin variety lettuce seeds, and Capital variety pea seeds were used in these experiments. The biological specimens were irradiated with gamma-rays at dose rates of 71.8 and 6.7 rad d^{-1} during the packaging of containers and after returning the samples to the laboratory. It was found that both on pre-radiation and post-radiation exposure space flight factors did not greatly influence radiobiological effects. (auth)

7923 EFFECTS OF SIMULATED SPACE VACUUM ON BACTERIAL CELLS. Buecker, H.; Horneck, G.; Facius, R.; Schwager, M.; Thomas, C.; Turcu, G.; Wollenhaupt, H. (Univ., Frankfurt am Main). pp 191-195 of Life Sciences and Space Research X. Vishniac, W. (ed.). Berlin; Akademie-Verlag (1972).

From 14th COSPAR meeting on life sciences and space research X; Seattle, Washington, USA (17 Jun 1971). See CONF-710615-.

The effect of vacuum on bacterial cells is related to water desorption. Below water vapour pressure the inactivation remains constant, independent of total pressure and exposure time. In subsequent growth, the lag-phase of the survivors is delayed. Combined treatment with vacuum and radiation (x rays or uv of 254 nm wavelength) results in synergistic effects, whereas vacuum and heat can act antagonistically. The vacuum inactivated cells (indicated as loss of colony-forming ability) are completely damaged. They do not show cellular elongation, phage production, or respiration. The cellular membrane becomes permeable by vacuum exposure: biomolecules are released from the cells when re-suspended after vacuum treatment. (auth)

7924 SYNERGISTIC CHARACTERISTICS OF THERMO-RADIATION STERILIZATION. Sivinski, H. D.; Reynolds, M. C. (Sandia Labs., Albuquerque, NM). pp 33-44 of Life Sciences and Space Research X. Vishniac, W. (ed.). Berlin; Akademie-Verlag (1972).

From 14th COSPAR meeting on life sciences and space research X; Seattle, Washington, USA (17 Jun 1971). See CONF-710615-.

Temperatures required for thermal sterilization are known to degrade certain heat-sensitive components, materials and products. Simultaneous application of lower temperatures and low levels of gamma radiation produces a synergistic effect that can sterilize with fewer damaging side effects. With this technique, sterilization times can be reduced significantly, for example, at 105°C and a dose rate of 7.5 krad per hour, the D value for B. subtilis var. niger spores decreases from 4.5 hrs for dry heat alone to 1.5 hrs when both are applied simultaneously. Other spore systems also exhibit this synergetic inactivation characteristic; those studied include B. stearothermophilus, B. pumilus, and some highly resistant soil spores. It was found that dose rate is a major factor to be considered in optimization of the synergism observed. Other effects studied include those of water activity and the use of a nitrogen atmosphere. (auth)

7925 INFECTIOUS DNA FROM COLIPHAGE T1. 4. The Action of Radicals Induced by ^{60}Co-Gamma Rays in the Wet State. Hotz, G. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Radiat. Biol.; 24: No. 1, 1-13(Jul 1973).

Infectious DNA from coliphage T1 was inactivated by ^{60}Co gamma rays. The influence of inactivating species from water radiolysis in a medium of high protein contents was studied. The effect of increasing concentrations of protein on radiosensitivity and on the occurrence of DNA double-strand breaks (dsb) was tested. Contribution of dsb to the inactivating event increased with increasing concentration of protein in the medium. Under these conditions about 60 per cent of the DNA molecules contained dsb. Metal-chelating agents (EDTA) protected infectious DNA very efficiently. The possible site of action and some properties this chemical has in common with compounds of the cysteine-cysteamine group are discussed. From experiments with phage particles, it was concluded that the protein membrane is a barrier to many radical scavengers and inactivating species in the medium, and that the phage specific organization of DNA influences the radiation damage to the polynucleotide in many respects. (auth)

7926 VIABILITY OF ONCOGENIC VIRUSES IN FEEDS. Dzhibilov, I. I.; Trubitsyn, B. I.; Voronin, E. S. (Scientific-Research Lab. for Experimental Biology, Moscow). Veterinariya; No. 10, 30-31(Oct 1972). (In Russian).

Fowl leukemia may be transmitted through the egg or through food, air, water, etc. intake. Using Rous sarcoma in in-vitro tests and in 7-day white Leghorn pullets and Japanese quail, it was established that irradiation of food containing the virus with an ultraviolet lamp for at least 1 hr, followed by storage for 2 weeks, completely inactivated the virus. Shorter irradiation times attenuated but did not destroy the virus. Vitamins, especially B, are also destroyed, so supplements to the feed so treated must be added. (TTT)

7927 SYNTHESIS OF RNA IN SACCHAROMYCES AFTER PHOTODYNAMIC TREATMENT OR IRRADIATION WITH X RAYS. Micheler, A.; Pietsch, I.; Lochmann, E. R. (Freie Univ., Berlin). Biophysik; 10: No. 3, 249-256(1973). (In German).

RNA synthesis in Saccharomyces has been investigated up to 10 h after x-irradiation or photodynamic treatment with thiopyronine and visible light. Even with high doses of x rays RNA synthesis is only very slightly inhibited in all cells up to about 2 h after irradiation. Then RNA synthesis decreases strongly in cells which cannot divide. On the contrary, after photodynamic treatment the inhibition of RNA synthesis in cells which lost their colony-forming ability begins immediately. In cells not inactivated in colony-forming ability, RNA synthesis shows nearly the same extend as control cells. These results give further supports that inactivation by photodynamic action in yeast cells is not caused by DNA damage, which is the case after irradiation with x rays, but by inactivating plasmatic structures. (auth)

7928 PHOSPHATASE ACTIVITY OF AN X-RAY INDUCED MUTANT OF ASPERGILLUS NIGER. Bhaskaran, R. (Tamil Nadu Agricultural Univ., Coimbatore, India); Venkataramanan, C. V.; Prasad, N. N. Curr. Sci. (India); 42: No. 23, 833(5 Dec 1973).

The efficacy of an x-ray induced mutant of Aspergillus niger in the release of available phosphorus from organic compounds in soil is reported. Conidial suspensions of A. niger were exposed to 15, 25, 50, 100, and 150 kR of x rays and ten single spore isolates were selected from each treatment and tested for their phosphates production. A mutant obtained at a dose of 15 kR showed a 91.7% increase in phosphatase activity when compared with controls. (ERB)

7929 INCREASED FREQUENCY OF AUXOTROPHIC MUTANTS OF USTILAGO HORDEI AFTER COMBINED UV IRRADIATION AND INOSITOL STARVATION. Thomas, P. L. (Dept. of Agriculture, Winnipeg, Manitoba). Can. J. Genet. Cytol.; 14: No. 4, 785-788(Dec 1972).

Auxotrophic mutants of Ustilago hordei were recovered after uv irradiation of a wild-type culture, inositol starvation of an inositol-requiring culture and a combination of the two methods. 1.9% of the survivors of uv irradiation followed by inositol starvation were found to carry a requirement additional to inositol. Inositol starvation by itself gave only 0.27% recovery while uv irradiation alone was even less efficient. (auth)

7930 INACTIVATION OF MYCOPLASMA IN SEED VIRUS STOCKS USING GAMMA RADIATION. Polley, J. R.; Fanok, A. G. (Dept. of National Health and Welfare, Ottawa). Can. J. Microbiol.; 19: No. 6, 709-714(Jun 1973).

A method was developed for the elimination of viable Mycoplasma in reference seed virus stocks. It was found that various species of Mycoplasma (such as M. pneumoniae, M. arthritidis, M. hominis, M. Salivarium, M. orale types I and II, M. meleagridis, and several unidentified species isolated from tissue cultures) were inactivated more rapidly by gamma radiation than all viruses tested. By the use of selected radiation doses, high concentrations of Mycoplasma species could be inactivated in virus suspensions of polioviruses types I and III, coxsackie viruses types A-7, A-9, B-3, and B-6, echoviruses types 1, 9, 12, and 20, herpes simplex, rubella, measles, and adenovirus type 7a, without inactivating all viable virus. After irradiation, the remaining viable virus could be propagated as well as the original strain and showed no change in reactivity with homologous or heterologous antisera. After storage for two months at -70°C, the irradiated virus showed no decrease either in viability or in specific reactivity. By this method, reference seed virus stocks could be prepared free of viable Mycoplasma species, without dependence on tissue cultures free of Mycoplasma. (auth)

7931 DNA REPAIR AND DEGRADATION IN X-IRRADIATED E. COLI B/r CELLS AFTER TREATMENT WITH ULTRA-VIOLET LIGHT AND N-ETHYLMALEIMIDE. Sapora, O.; Simone, G.; Quintiliani, M. (Institute Superiore di Sanita, Rome). Int. J. Radiat. Biol.; 24: No. 1, 99-105(Jul 1973).

A study was made of the effect of 5×10^{-4}M N-ethylmaleimide (NEM) on the survival of Escherichia coli cells that had or had not been previously exposed to ultraviolet radiation at 600 or 1200 ergs/mm^2 before irradiation with x rays in suspensions saturated with air or nitrogen. The dose range of the x rays was 0 to 70 Krads. The enhancement by ultraviolet of the response to x rays in air was slightly more pronounced in N_2. NEM sensitized control cells to a greater extent in anoxia, but in air had practically no effect on cells previously exposed to 600 ergs/mm^2, and actively protected cells previously exposed to 1200 ergs/mm^2. In N_2, the results concerning cells previously exposed to uv light were qualitatively the same as in air, but significantly less evident. In air the protective effect of NEM was reduced by ~40% in cells photoreactivated after exposure to 1200 ergs/mm^2 of uv light, and before the addition of NEM and x irradiation. In N_2, the sensitizing activity of the drug was partially restored by photoreactivation. In the presence of NEM, it was shown that a greater number of single-strand DNA breaks was produced immediately after x irradiation. These were repaired out at a slower rate than under control conditions (30% versus 65% of breaks repaired in 80 min). In cells exposed only to uv light, there was no evidence of single-strand breaks immediately after exposure, but they appeared after incubation and were repaired to about 60% after 40 min. In cells exposed

to uv and then to x rays, the number of breaks immediately after irradiation appeared to be the same as in those treated only with x rays, but after 40 and 80 min there was evidence of extensive DNA degradation with no repair. In the combined treatment with uv, NEM, and x rays, the number of breaks immediately after irradiation corresponded to that of samples treated with NEM and x rays, with a slow but significant repair taking place. (UK)

7932 γ RAY-INDUCED SMALL PLAQUE MUTANTS OF WESTERN EQUINE ENCEPHALITIS VIRUS. Simizu, B.; Yamazaki, S.; Suzuki, K.; Terasima, T. (National Inst. of Health, Shinagawa, Japan). J. Virol.; 12: No. 6, 1568-1578(Dec 1973).

Small plaque mutants of Western equine encephalitis virus were obtained from the surviving fractions of wild-type virus which was irradiated with gamma rays. The frequency with which small plaque mutants appeared in the surviving fraction increased with the radiation dose. These mutants were not more resistant to radiation than wild-type virus. The growth rate of a mutant, S127, was lower than that of wild-type. Clonally purified mutant virions presented two peaks in a velocity sedimentation profile; peak 1 corresponded to the peak of wild type and peak 2 moved faster than peak 1. Virions of both peaks were infectious and consistently formed small plaques in chicken embryo cells. Virions reisolated from either peak and grown in chicken embryo cells also revealed two peaks in sedimentation analysis. In the electron microscope examination peak 2 proved to consist of giant form particles, each of which contained more than one nucleoid surrounded with a common envelope. Despite this remarkable morphological difference, densities of the wild-type and S127 mutant virions were similar in cesium chloride gradients. The RNAs and proteins of mutant virions could not be distinguished from those of wild types on the basis of size or charge. (auth)

7933 ANALYSIS OF MINIMAL FUNCTIONS OF SIMIAN VIRUS 40. II. Enhancement of Oncogenic Transformation in Vitro by uv Irradiation. Seemayer, N. H.; Defendi, V. (Wistar Inst. of Anatomy and Biology, Philadelphia). J. Virol.; 12: No. 6, 1265-1271(Dec 1973).

After light uv irradiation (5,000 to 10,000 ergs/mm^2) complete and defective simian virus 40 (SV40) showed an enhancement of oncogenic transformation capacity in Syrian hamster kidney cells in vitro up to 180 and 270% of the controls, respectively. Simultaneously with the enhancement of transformation, an increase in T-antigen induction was observed in CV-1 cells infected with light uv-irradiated SV40; infectivity, however, was correspondingly reduced by 1 $\log_{10}$. After strong uv irradiation (10,000 to 80,000 ergs/mm^2) of complete and defective SV40, transformation capacity in vitro proved to be the most resistant viral function. It was only slightly reduced in comparison with a 4 to 5 $\log_{10}$ reduction of infectivity. T-antigen induction of SV40 was also equally resistant to strong UV irradiation. No evidence was found of multiplicity reactivation involved in the high resistance of transformation capacity of SV40 after uv irradiation. Syrian hamster kidney cells transformed in vitro by uv-irradiated SV40 contained the SV40-specific T-antigen and showed the same morphology and growth characteristics as cells transformed by non-irradiated complete or defective SV40. They induced malignant tumors after subcutaneous inoculation into Syrian hamsters. (auth)

7934 REACTIVATION OF PHOTOINACTIVATED SINGLE-STRANDED DNA BACTERIOPHAGE φX175 BY UV-IRRADIATED ESCHERICHIA COLI CELLS. Bandopadhyay, U.; Poddar, R. K. (Saha Inst. of Nuclear Physics, Calcutta). J. Virol.; 12: No. 6, 1204-1208(Dec 1973).

Reaction of single-stranded DNA phage, photodynamically inactivated in the presence of proflavine sulfate, by three isogenic Escherichia coli strains having different DNA repair capabilities was studied. Reactivation of photoinactivated φX174 was possible only if the host cells were recombination proficient (recA$^+$) and had been lightly irradiated with uv light prior to infection; the presence of the uvrA$^+$ gene was not essential. Only a small part of the proflavine-mediated photodynamic damage in φX174 could be repaired in this fashion. Burst sizes of reactivated phages were, however, comparable to those of normal unirradiated phages. (auth)

Radiation Effects on Plants

Refer also to abstracts 7917, 7921, and 7922.

7935 (INIS-mf-112) COMPARATIVE STUDIES ON FAST NEUTRON AND GAMMA RAY-INDUCED MUTATION AND GERMINATION RATES IN BARLEY (HORDEUM VULGAE L.). Kramer, J. (Hochschule fuer Bodenkultur, Vienna (Austria)). May 1970. 110p. (In German). INIS.

The effects of various modifying factors were studied on fast neutron- and γ-induced mutation and germination rates in barley. The water content of dormant seeds and the oxygen concentration during and after irradiation affect radiosensitivity. Only the water content influences the effects of fast neutrons. The degree of imbibition of seeds very markedly affects their radiosensitivity. Increased soaking causes γ radiation to produce a greater reduction in survival rate, chlorophyll mutation frequency, and fertility than fast neutrons. Soaking, with subsequent drying, increases the radiation effects of both. Soaking in 0.1 m cystein very markedly influences the germination of neutron- or γ-irradiated barley seeds, but affects the chlorophyll mutation rate only slightly. The survival rate of γ-irradiated seeds goes up with increasing imbibition. Soaking in 0.1 m cystein, with subsequent drying, increases the germination of barley seeds, following γ- but not fast-neutron-irradiation. Cystein does not appear to affect the chlorophyll mutation rate. No differences were observed in the chlorophyll mutation spectrum of neutron- and γ-irradiated seeds. Seeds treated with fast neutrons or ethyl methanesulfonate (EMS) showed no differences in macromutation frequency, but double the chlorophyll mutation frequency was obtained with EMS. Of 15 mutants selected for early ripening, 9 proved genuine. The two Erectoides mutants tested showed clear differences in stalk and spike length, but no significant difference in yield between the mutant and the original Union strain could be established. (auth)

7936 (INIS-mf-705) PHYSIOLOGICAL STUDIES ON RADIATION EFFECTS IN PLANTS. Joseph, B. (Bombay Univ. (India)). 1972. 181p. INIS.

Thesis.

The effects of x radiation on the morphological characters of barley seeds (Hordeum vulgare var. Himalaya) during germination and early seedling growth were studied. The materials and methods used for the irradiation as well as the estimation of morphological and physiological parameters are described in detail. Various factors such as germination and growth, including elongation and fresh and dry weights, are discussed. Preliminary dose selection studies revealed that x ray doses of 0.4 and 1.6 kr were stimulatory to plant growth, and a dose of 45 kr proved inhibitory. A correlation between physiological changes and morphological growth was observed. ^{14}C-Leucine incorporation studies showed that an initial enhancement of protein synthesis seemed to occur even in 45 kr-treated seeds. The activity of the proteolyctic enzyme, protease, which hydrolyses proteins into amino acids was found to increase with low dose treatment. It is inferred that radiation induced stimulation and inhibition of growth in the germinating irradiated barley seeds are dose dependent. These morphological responses find good correspondence with the radiation effects on basic physiological processes like carbohydrate and protein metabolism and respiration. (auth)

Radiation Effects on Animals

Man

Refer also to abstracts 7646, 7698, 7699, 7707, 7708, and 9249.

7937 (BNWL-tr-91) OCCUPATIONAL ILLNESS IN THE URANIUM INDUSTRY. Pacina, V. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). [nd]. Translation of a Czech Paper. 30p. Dep. NTIS $3.50.

A review is presented of occupational diseases and industrial poisoning as they occur in the uranium industry. Some topics discussed are: legal aspects of occupational diseases; specific risks due to radon and its decay products, external gamma radiation, and airborne uranium dusts; effects of alpha particles from sources adsorbed on dust on respiratory tract; incidence of lung cancer in uranium miners; preventive measures against lung cancer; symptoms and treatment of vasoneurosis and vibration damage; hearing damage due to excessive noise; and poisoning following blasting due to gases such as carbon dioxide, carbon monoxide, nitrous gases, and sulfur dioxide. (HLW)

7938 (CONF-730627-, pp 202-208) INTERACTIVE PROGRAM FOR THE CALCULATION OF ABSORBED DOSE FROM RADIATION. Flowers, W. M. Jr.; Smith, R. O. (Univ. of Mississippi, Jackson). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

Interactive computer programs can relieve the nuclear medicine physician of the tedious computations required by absorbed dose calculations, yet allow him to remain in full control of the calculation process. The requirements for developing such software are discussed, and an example computer program, written in the BASIC language, is included. (auth)

7939 (FOA-4-4542-A-3) GENETIC HAZARDS OF IONIZING RADIATION. A Summary. Rydberg, B. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Jun 1973. 26p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.50.

A short description is made of the experimental and theoretical background of estimations of the genetic effects of ionizing radiation. As an example estimations of the effect on future generations after a single dose of 100 rad to a large population of people are shown. (SW)

7940 (FOA-4-4546-A-4) PROPOSAL FOR DEVELOPMENT OF A METHOD FOR BIOLOGICAL DOSIMETRY. Rydberg, B. (Foersvarets Forskningsanstalt, Stockholm (Sweden)). Jul 1973. 12p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

The frequency of chromosome aberrations in leukocytes may be used as a measure of the radiation received by a person. A literature survey is presented of different methods. Different methods for separation of aberrated chromosomes from normal ones are described including chromatographic methods, electrophoresis, centrifugation, and calculation of chromosomes in suspension. (SW)

7941 (LIB/TRANS-513) CHROMOSOME ABERRATIONS FOLLOWING REPEATED GASTRIC ROENTGEN EXAMINATIONS. Hajdu, I.; Balogh, I.; Forgacs, S.; Czeizel, E. Translated from Orv. Hetil.; 112: No. 31, 1834-1838(1971). 9p. Dep. NTIS (U. S. Sales Only) $3.00.

This abstract prepared for the paper from the original language appeared as NSA 26:53427. In order to examine the known radiation injury of chromosomes after repeated exposure to x radiation, the chromosomes in leukocytes of 50 patients in the reproductive age group subjected to diagnostic x radiation because of sickness of the digestive tract were examined for aberrations. Each of the patients, aged 23 to 41 years, experienced at least 3 diagnostic radiographic examinations, but were not subjected to any therapeutic x-ray treatment. The man : woman ratio of the group was 27 : 23. During the 10-minute long flouroscopic radiographic examination of the stomach the stomach wall is exposed to a dose of about 100 to 150 R; the gonad dose was estimated at 500 mR. In every case 50 dividing cells in the peripheral blood were examined in order to determine the occurrence of mitotic cells with chromosome anomalies. In 38.8% of the 36 cases for which the examination were completed, dicentric chromosomes, considered the most sensitive indicators of radiation injury, were observed. No chromosome anomalies were detected in the control group. In view of the potential danger of stomach x-ray examinations for the populations, it is recommended to limit them strictly; not only radiologists but clinicians requesting such examinations should be advised of this genetic risk. (TTT)

7942 (SSI-1972-21) REPORT FROM THE FILM DOSIMETER SERVICE, 1971. Snihs, J. O. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Jun 1972. 14p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

Tables are given of radiation doses received by personnel at medical, scientific, and technical institutions and laboratories in Sweden. Personnel doses received at the Atomic Energy Company of Sweden and a few hospitals with their own film dosimeter services are excluded. Gamma, β, and x radiation doses are registered. (SW)

7943 (SSI-1973-1) PHYSICAL ASSUMPTIONS CONCERNING RADIOTHERAPY OF THE HYPOPHYSIS WITH NARROW X-RAY BEAMS FROM A LINEAR ACCELERATOR. Arndt, J. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Jan 1973. 29p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.50.

An investigation was made of the assumptions of treatment of different types of illnesses of the hypophysis using irradiation with narrow x-ray beams from a linear accelerator. The irradiation procedures are based on field angle distribution technique. Isodose curves and radiation dose distributions were determined on a tissue equivalent phantom. Analysis is made of errors of the photographic dosimetry. (SW)

7944 (SSI-1973-14) FINGER EXPOSURE FROM THE HANDLING OF SHORT-LIVED RADIONUCLIDES. Magi, A.; Santa, K. (Statens Straalskyddsinstitut, Stockholm (Sweden)). Jun 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

Finger radiation doses were measured on medical personnel who handle different injection solutions containing short-lived radionuclides such as ^{99m}Tc and ^{113m}In. A survey is given of different dosimetric methods used in other places. The dosimeters used in this investigation were 25 mg LiF ribbons. The measurement procedure is described. The calibration was made using a ^{60}Co therapy unit source and phamtoms of fingers. Doses were calculated for each individual for each radionuclide separately. (SW)

7945 MODERN TRENDS IN RADIOTHERAPY. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972). 322p.

Separate abstracts were prepared for 19 chapters included in this book. (CH)

For abstracts of individual chapters see: 7908, 7946–7961, 8158, and 8159.

7946 APPLICATION OF RADIOBIOLOGY TO RADIOTHERAPY. Windeyer, B. (Middlesex Hospital Medical School, London). pp 1-11 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York.; Appleton-Century-Crofts (1972).

Developments in radiotherapy since the discovery of x-rays and radium some 75 yrs ago are reviewed. It was soon observed that in addition to the destruction or arrest of growth of neoplasms there were many instances of severe damage to human tissues caused by exposure to radiation. As a result of these observations, attention was drawn to the need for the study of radiological protection and national and international organizations were set up to prescribe safe working conditions. The organization of centralized institutions for radiotherapy led to the development of equipment and training of personnel interested in radiation dosimetry and radiobiology, which in turn led to a fairly constant and uniform standard of results. These improvements are enumerated and discussed briefly. (CH)

7947 CELL POPULATION KINETIC MODELS IN RADIOTHERAPY. Cohen, L. (General Hospital, Johannesburg). pp 31-50 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The development of a kinetic model to simulate the effects of fractionated radiotherapy of neoplasms is described. It allows for both single-target and multi-target lethality functions and a logistic regeneration cycle repopulating the depleted tissues between fractions. The model can be used in a computer program to predict the outcome of any given radiotherapy procedure provided the best-fitting parameters for various tissues and tumors are included. The model may also be used to generate a table of tumor lethal doses and normal tissue tolerance limits for use in planning radiotherapy schedules. (CH)

7948 RADIOSENSITIVITY: SIMULTANEOUS ULTRASONIC AND IONIZING RADIATION. Spring, E. (Univ. Central Hospital Radiotherapy Clinic, Helsinki). pp 51-58 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The possibility of using simultaneous ultrasonic and ionizing radiation for the treatment of neoplasms of the human lung is considered. Autopsy findings in cases of lung cancer treated by conventional megavoltage radiotherapy with total doses of 4,000 to 7,000 rad showed that radiotherapy was effective in only 30% of the cases. It is pointed out that little is known about the effects of combined ultrasonic and ionizing radiations on cells or tissues. Data are tabulated from five studies on biological materials. Two hypothetical methods of radiotherapy of lung neoplasms using simultaneous ultrasonic and ionizing radiations are described. (CH)

7949 ASPECTS OF IMMUNOLOGY IN RADIOTHERAPY. James, K. W. (Ipswick Hospital, Suffolk, Eng.). pp 77-97 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The evidence for specific cancer antigens in man is reviewed and the possibility of the use of this knowledge in the development of immunotherapy is discussed. It is pointed out that immunotherapy has not been proved of value so far. (CH)

7950 EXTRACORPOREAL IRRADIATION OF THE BLOOD. Lajtha, L. G. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 98-116 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

Applications of extracorporeal irradiation of the circulating blood in human patients as a possible therapeutic method in leukemia, as a potential immunodepressant, and as a tool for the study of hematopoietic cell kinetics are discussed. Methods, radiation sources, and radiation dose and dose rate are reviewed. It is concluded that the method is not likely to be of major importance in the treatment of leukemia unless an efficient method is found of mobilizing the leukemic cells into the circulation. (CH)

7951 COMPUTERS IN RADIOTHERAPY: CLINICAL APPLICATIONS. Deeley, T. J. (Velindre Hospital, Cardiff, Wales). pp 117-122 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The advantages of computerized data processing systems for the processing of records of radiotherapy are pointed out. These include: recording of the continuing care of the patient throughout treatment and follow-up; recording the outcome of certain treat-

ments or the effects of various factors on the progress of the disease and its prognosis, as well as the results of controlled clinical trials; and providing a record of the number, sex, age, and other characteristics of the patients treated, the number of different malignant diseases treated over a period of time, and any other information that may improve the administrative procedures of the department or hospital. (CH)

7952 PRE-OPERATIVE RADIOTHERAPY. Nickson, J. J. (Michael Reese Hospital, Chicago); Glicksman, A. S. pp 123-149 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The rationale for pre-operative radiotherapy of neoplasms is discussed. It is pointed out that patients highly curable by either radiation or surgery will not benefit much from the combined treatment, but that many moderately advanced neoplasms have a poor prognosis and the possibility that planned sequential radiation and surgery may be of benefit should be explored. The potentialities for combined irradiation and surgery in the treatment of neoplasms of the head and neck, breast, lungs, esophagus, rectum and colon, kidneys, bladder, uterus, and ovary are examined critically. (CH)

7953 IMPORTANCE OF ANAEMIA IN DETERMINING PROGNOSIS. Newall, J. (New York Univ., NY). pp 150-156 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The relationship of anemias to the prognosis of malignant disease is discussed. Emphasis is on the limitations placed on a course of radical radiotherapy by the degree and cause of anemia in patients. (CH)

7954 BLOOD PRESSURE AS A FACTOR IN RADIOTHERAPY. Jenkin, R. D. T. (Princess Margaret Hospital, Toronto). pp 157-164 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The response of human tissues to radiation in the presence of hypertension is discussed in relation to the response of neoplasms to radiotherapy. Data are reviewed from clinical studies that showed that high blood pressure was associated with a decreased chance of survival of patients with neoplastic diseases, an increased probability of recurrence of the neoplasm at the primary site following radiotherapy, but a decreased probability of radiation complications. It is concluded that if there is a choice between surgery and radiotherapy for the hypertensive patient, the finding of high blood pressure would favor surgery. (CH)

7955 TREATMENT OF CARCINOMA OF THE BREAST. Bond, W. H. (Queen Elizabeth Hospital, Birmingham, Eng.). pp 165-175 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The effectiveness of radiotherapy, surgery, and a combination of the two with and without regional lymph node irradiation or removal, for the treatment of carcinoma of the breast is discussed. Evidence for a host defense mechanism that slows the growth rate of cells of the primary neoplasm is reviewed. The importance of treatment before metastatic cells have invaded the lymph nodes is stressed. (CH)

7956 STRONTIUM BEAM THERAPY. Bratherton, D. G. (Addenbrooke's Hospital, Cambridge, Eng.). pp 176-187 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The design features of a moving ^{90}Sr β radioapplicator for the treatment of skin lesions over large body areas are described. Applications of the unit in the treatment of both benign and malignant lesions are discussed. The radiation dose used and results are reported for patients with squamous cell carcinoma, mycosis fungoides, psoriasis, and chronic eczema. (CH)

7957 FAST NEUTRON THERAPY. Greene, D. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). pp 220-246 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

It is pointed out that the value of fast neutron therapy of neoplasms is at present an unknown quantity when measured in terms of patient survival. Results of radiobiological studies, using the survival of cultured cells as the criteria, indicate a lethal effect may be obtained in cells of anoxic tumors. Studies on tumor and normal tissue reactions to neutron irradiation carried out to date have all been conducted on patients in the late stages of cancer. The effectiveness of various types of neutron generators for use for therapy are considered from the standpoint of depth dose values, beam quality, and output. The problems of setting up a suitable clinical trial of neutron therapy are discussed briefly. (CH)

7958 CLINICAL DOSIMETRY. Cohen, M. (London Hospital). pp 247-265 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

Methods for calculating and measuring the radiation dose received by neoplasms during therapy are reviewed. Emphasis is placed on the use of computers in treatment planning. The integration of basic physical data, patient data, computational methods, dose distribution data, treatment schedule, and dose verification in clinical dosimetry is discussed. (CH)

7959 ISODOSE PLANNING USING CLOSED CIRCUIT TELEVISION. Smith, C. W. (Velindre Hospital, Cardiff, Wales). pp 266-284 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The closed circuit television method of producing isodose distributions of radiation doses for patients awaiting radiotherapy is discussed. Among the advantages of the method are the instantaneous display of distribution; the ease with which the distribution can be changed; the opportunity for the optimum treatment plan to be achieved; and the fact that the distribution can be recorded on Polaroid film so that a library of distributions can be produced for reference and teaching purposes. (CH)

7960 COMPUTERS IN RADIOTHERAPY: PHYSICAL USES. Wood, R. G. (Velindre Hospital, Cardiff, Wales). pp 285-295 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The most important application of computers in radiotherapy is in the calculation of the absorbed radiation dose distribution in patients from either external or internal sources of radiation. It is pointed out that computers should provide more accurate treatment plans and also provide plans previously unobtainable on account of the time and labor involved. Economic aspects of the use of computers for dose calculations and possible difficulties are discussed. It is pointed out that accuracy, computing time, and cost are interdependent. Various methods of displaying the final dose distribution selected are discussed. It is concluded that the computer can function as a real-time simulator, a treatment monitor, a source machine controller, and a data processor. (CH)

7961 TREND OF FUTURE DEVELOPMENTS IN RADIOTHERAPY. Deeley, T. J. (Velindre Hospital, Cardiff, Wales). pp 296-306 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

Advances in the treatment of cancer since the establishment of the first Free Cancer Hospital in 1852 are reviewed with emphasis on developments in radiotherapy. It is pointed out that, while the goal of radiotherapy is to increase the proportion of patients with neoplastic diseases who can be cured with the minimum damage to normal tissues, radiotherapy may also be of value for controlling the rate of growth of the neoplasm and to palliate distressing symptoms. The value of surgery, chemotherapy, and radiotherapy, alone or in combination, for the management of patients with neoplastic diseases is discussed. Areas are listed in which it is concluded that research should be carried out and in which improvements in early diagnosis and in the rehabilitation of patients should be made. (CH)

7962 ANTIEMETIC EFFECT OF BENZQUINAMIDE IN GENERALIZED RADIATION REACTION. Kleibel, F.; Immich, H. (Univ., Heidelberg). Ther. Gegenw.; 112: 820-828(May 1973). (In German).

On radiotherapy patients, a double-blind study was performed with benzquinamide and trifluprom azine. Among 85 patients receiving benzquinamide, the antiemetic effect was good in 53, mediocre in 20, and negligible in 12. Among 87 patients receiving trifluprom azine, the antiemetic effect was good in 46, mediocre in 23, and negligible in 18. Benzquinamide thus was at least as effective as trifluprom azine in the prevention of radiation-induced nausea and vomiting. (HBG)

7963 DELAYED RADIATION EFFECTS IN CHILDREN (FETUSES) EXPOSED TO THE A-BOMB. Kato, H. (National Inst. of Health, Hiroshima). Igaku No Ayumi; 84: No. 13, 754-759 (Mar 1973). (In Japanese).

Among those born between 1945 August and 1946 May in Nagasaki and Hiroshima, those whose mothers were exposed to the atomic radiation within the distance of 2 km from the center of bombing were investigated in regard to delayed radiation effects. Those whose mothers were exposed to low-dose irradiation at the far distance from the center and those non-irradiation cases were also examined as control. Among 1292 investigated cases (1,073 of Hiroshima and 219 of Nagasaki), 196 were dead by 1969 according to the investigation conducted by ABCC during 1945 to 1969, in which the death rate of infants less than 1 year old was in proportion to the exposure dose of their mothers. However, no relation was observed between the death rate and exposure dose for those children with age between 1 year old and 9 years old. Cases of microcephalus and mental retardation were observed among those whose mothers were exposed to over 50 rad in Hiroshima and over 200 rad in Nagasaki, in particular those who had

been within 15 weeks of age as fetuses at the time of bombing. The antibody response of those children seemed to return to normal level when they reached about 10 years old. The frequency of chromosomal aberration was observed higher among those exposed to a higher radiation dose, however, no clinical significance was obtained. Among those whose mothers received more than 10 rad, 4 to 8% of males and 20 to 30% of females now have children, no clinical effects were observed so far in regard to genetic radiation effects. No difference was observed in sex ratio of children born in the second generation of irradiated cases, however observation should be continuously carried out. (JA)

7964 COMPARISON OF THE CHROMOSOME DAMAGE INDUCED BY RADIATION AND CYTOXAN THERAPY IN LYMPHOCYTES OF PATIENTS WITH GYNECOLOGICAL TUMORS. Schmid, E.; Bauchinger, M. (Univ., Munich). Mutat. Res.; 21: No. 5, 271-274(Oct 1973).

In peripheral lymphocytes, cytoxan therapy preferentially caused another type of chromosomal damage than radium-x-ray therapy. After cytoxan, open breaks with predominating aberrations of the chromatid-type accompanied by a great number of achromatic lesions were present. In contrast, after irradiation, a great number of rejoining processes occurred. The predominating aberrations were of the chromosome type. (auth)

7965 MICRO-MIXED LEUKOCYTE CULTURE TECHNIQUE USING WHOLE BLOOD. Stockman, G. D.; Mumford, D. M.; Wilbur, J. R. (Baylor Univ., Houston, TX). Int. Arch. Allergy Appl. Immunol.; 43: No. 5, 759-765(1972).

Micro-mixed leukocyte cultures (MMLC) using whole human peripheral blood were compared with standard macro cultures using separated leukocytes. The MMLC were found to be of comparable sensitivity to the macro test, with the added advantages of requiring less blood and fewer technical manipulations in the performance of the test. One-way MMLC were performed using either x-irradiated whole blood (MMLC-X) or mitomycin C-treated leukocytes (MMLC-MC) as stimulating cells. Both techniques gave similar results. The MMLC system is ideally suited for the testing of immune deficient infants and other pediatric patients and is currently being employed for these purposes. (auth)

7966 METHODS FOR THE ANALYSIS OF HUMAN CHROMOSOME ABERRATIONS. Buckton, K. E.; Evans, H. J. (Eds.). Geneva; World Health Organization (1973). 66p.

Some of the information available from ionizing radiation studies (on which more information is available than on other mutagens) is presented and techniques for this work are described. In addition, some of the difficulties and pitfalls in the scoring of chromosome aberrations and in their utilization for biological dosimetry are described. Certain chemical mutagens can induce aberrations in human cells, and many of the technological problems encountered when chromosome and chromatid aberrations are used for estimating radiation dose are also relevant to the study of the chromosome-damaging effect of other mutagens. The study of a single individual, several individuals, or a population exposed to mutagenic agents is not a simple task. In the case of a single individual or several individuals, it is necessary to obtain good chromosome preparations and to score a minimum of 200 cells per person and a similar number of cells from matched controls. Such a study requires considerable time and expertise. A further aim of this manual is to describe standard methods for obtaining good chromosome preparations from human material and a system of scoring and data recording that is considered by an international group to be the best available at present. The use of this system would make it easier to compare data on chromosome aberration frequencies from different laboratories. (auth)

7967 EVALUATION OF EFFECTS OF HIGH NATURAL BACKGROUND RADIATION ON SOME GENETIC TRAITS IN THE INHABITANTS OF MONAZITE BELT IN KERALA, INDIA. Ahuja, Y. R. (Indian Agricultural Research Inst., New Delhi); Sharma, A.; Nampoothiri, K. U. K.; Ahuja, M. R.; Dempster, E. R. Hum. Biol.; 45: No. 2, 167-179(May 1973).

With a view to assess the possible long-term effects of chronic low-level radiation on human quantitative characters, several dermatoglyphic parameters were studied among the inhabitants of monazite belt in Kerala, India. Previous investigators have estimated that these populations are exposed to 87R per 30 years. Dermatoglyphic data from 74 males native to this area were compared with those from 72 ethnically comparable males native to another area exposed to near-normal levels (6R per 30 years) of background radiation. All the six quantitative characters so studied showed lower variance among the exposed population as compared to the controls. Two possible interpretations were considered to account for this somewhat puzzling finding. The exposed population may have originated from a small group of possibly related individuals; then subsequent expansion of the population may have occurred in the absence of significant additional immigration. The effects of chronic low level radiation may not be the same as those of high acute doses; the former may sometimes decrease rather than increase variance of quantitative traits. (auth)

7968 ORAL CARE IN RADIATION THERAPY. Broude, D. J.; Waite, D. E.; Levitt, S. H. (Univ. of Minnesota, Minneapolis). Minn. Med.; 56: 581-585(Jul 1973).

Patients receiving radiation therapy involving the oral cavity and contiguous structures require specialized and individualized care under a team of experienced clinicians. The oral health problems of these patients are reviewed. The preparation of the oral cavity for radiation includes the removal of gross sepsis, extraction of questionable teeth, and patient education. During the radiation period the use of fluoride treatments, establishment of good oral health regimens including lavage and brushing, and maintenance of good nutrition are necessary. (auth)

7969 EXPOSURE TO RADIATION IN DENTAL RADIOLOGY. Mlosek, K. (Inst. of Radiology, Warsaw). Czas. Stomatol.; 26: No. 4, 411-415(Apr 1973). (In Polish).

Radiological investigations are the greatest additional source of exposure of the population to ionizing radiation causing not only harmful somatic consequences but being a cause of genetic risk. Radiological investigations should be used, therefore, only according to strict medical indications. (auth)

7970 REVERSE DERMAL-FAT FLAP: AN ALTERNATIVE CROSS-LEG FLAP. Clodius, L.; Smahel, J. (University Hospital, Zurich). Plast. Reconstr. Surg.; 52: No. 1, 85-87(Jul 1973).

After a large single dose of radiation, the resulting ischemic ulcer of the sole of the foot was repaired with a reverse dermal flap. A good result was obtained, demonstrating that this can be used as an alternative to a cross-leg flap in some instances. (auth)

7971 GROWTH DISTURBANCES OF THE SKELETON FOLLOWING RADIOTHERAPY AND THEIR TREATMENT. Schulitz, K. P.; Aalam, M. (Univ., Heidelberg). Z. Orthop. Ihre Grenzgeb.; 111: No. 3, 249-257(1973). (In German).

The pathological changes in the growing skeleton due to therapeutic irradiation are discussed on a number of examples. Radiotherapy of a growing patient may lead to hypoplasia, joint-deformities, irradiation necrosis of bone, and scolioses. Hypoplasia is the mildest form of growth disturbance that calls for treatment with apparatus or surgery only, if there is distinct shortening of a leg. Joint deformity is due to selective damage to parts of the epiphyses. Deformity may call for correction by osteotomy or sliding operations on the soft parts. Radionecrosis of bone is due to damage to the osteoblasts that occurs in general after high dosage irradiation. This results clinically in pseudarthroses. When submitting Wilmstumors or sympathicoblastoma to radiotherapy, scolioses may result. They are in general mild and have a good prognosis. (auth)

7972 NUCLEAR ENERGY AND POPULATION PROTECTION. Schwibach, J.; Winkelmann, J. (Bundesgesundheitsamt, Neuherberg, Ger.). Bundesgesundheitsblatt; 16: No. 15-16, 226-230 (1973). (In German).

Hazards of nuclear technology (accident risk, reactor safety, environmental exposures) and forecasts of the energy demand (world energy demand, world population growth, number of nuclear power plants, global effects of the increasing energy demand are discussed. (GE)

7973 EXPOSURE TO RADIATION. Oldman, R. (Groby Road Hospital, Leicester, Eng.). Brit. Med. J.; 4: No. 5888, 356-357(10 Nov 1973).

Brief criticism is made of a previous editorial (Br. Med. J. v.4, p.510 (8 Sep 1973)) on the difficulties of assessing radiation risk to the individual from occupational exposure, radiological diagnosis, or fallout. It is pointed out that the scientific problem is worse than it need be, because methods of data presentation can be misleading, e.g., general radiation exposure of the populace/year might not distinguish between external and internal dose. It is suggested that dose averaging may be acceptable in considering genetic effects, but it is not acceptable in assessing radiation carcinoma and leukemia risk. It is pointed out that the worst anomaly is in the collection of radiation records, and the need is stressed for centralization of records to cover doses received by individuals from all sources, both occupational and medical. (UK)

7974 RADIOLOGICAL PROTECTION IN DENTISTRY. Holliday, B. (National Radiological Protection Board, Harwell, Eng.). Brit. Dent. J.; 134: No. 36, 495-497(5 Jun 1973).

Information that would allow an assessment of the standard of

radiological protection in the United Kingdom is very limited. The Radiological Protection Service (now the National Radiological Protection Board) has provided a monitoring and advisory service to dentists for many years but very limited use has been made of this service. In a recent survey a total of 114 dentists was visited in representative practices in South East England and it was established that only 6.5 per cent of dentists in general practice do not use radiography as an adjunct to their practice (Smith, 1969). In the 88 x-ray sets which were examined, 24 per cent had less than the recommended thickness of aluminium filtration, while 25 per cent had a fixed field size which was larger than necessary for dental radiography, in addition 27 per cent of the timers were found to have an error of greater than 20 per cent in repetition of the pre-set exposure time. These figures are consistent with the results of surveys performed by the National Radiological Protection Board at the request of dentists, but the sample has been small, i.e., a few per cent of dentists in general practice. It is also possible that these results are not typical as the dentist requesting such a survey may have a greater awareness than others of the need for protection. (auth)

7975 ADJUVANT THERAPY FOR ADENOCARCINOMA OF THE KIDNEY: PRESENT POSITION AND PROSPECTS. Bloom, H. J. G. (Inst. of Cancer Research, London). Brit. J. Urol.; 45: No. 3A, 237-257(Jun 1973).

Although the only hope of cure for patients with adenocarcinoma of the kidney rests with nephrectomy, this operation fails to prevent death from this disease within 5 years in at least 50% of surgical cases. Attention is now being directed to ancillary methods of treatment which may augment or assist the main surgical attack on the primary tumour, and thereby prevent or delay the development of local recurrence and distant metastases. The present communication is concerned with these methods which may be considered. The methods include radiotherapy, cytotoxic drugs, hormones, and immunotherapy. (auth)

7976 ENVIRONMENTAL RADIATION UNDER ATTACK. Environ. Sci. Technol.; 7: No. 13, 1104-1105(Dec 1973).

7977 PATHOLOGICAL PROPERTIES OF FUNGI FROM RADIOACTIVE URANIUM MINES AND PREVENTIVE TREATMENT POSSIBILITIES FOR URANIUM MINERS. Adamek, M.; Adamek, R.; Fassatiova, O.; Ransberger, K. (Nationales Gesundheitsinstitut, Prague). Mykosen; 15: No. 9, 353-357(1972). (In German).

The behavior of lower fungi from uranium mines which existed in an environment of considerable radioactivity was studied. The significance of the fungi for mine workers was also examined. In animal experiments it was found that the conidia of the fungi were able to spread throughout the entire body, probably along the lymphatic system. The experimental animals showed accumulations of conidia in liver, spleen, and lungs. (tr-auth)

7978 SEVENTY-FIVE YEARS OF RADIATION PROTECTION. Oliver, R. (Hammersmith Hospital, London). Brit. J. Radiol.; 46: No. 550, 854-860(Oct 1973).

The history of radiation protection is reviewed. As early as 1898 the Röntgen Society set up a Committee to report on the alleged injurious effects of x rays. In 1915 the Society published a set of protection rules for x-ray operators, and in 1918 Russ started a hospital film badge service. The report of the British and Radium Protection Committee published in 1921 formed the basis of the first international recommendations in 1928 and the Institute and its members have continued to contribute to the work of ICRP. The development of atomic energy, both for weapons and for power and radioisotope production, led to a rapid expansion of radiation work and the establishment of health physics as a profession. But diagnostic radiology remains the major source of population irradiation, so that efforts to reduce this exposure while still exploiting the medical advantages of radiological procedures, and consideration of the risk/benefit balance in this connection, remain subjects particularly suited to discussion by the Institute with its interdisciplinary membership of clinicians, scientists, and engineers. (auth)

7979 OCCUPATIONAL DISEASES OF DENTISTS. Damages From X Radiation (Statistical Studies). Gennari, U.; Galli, S. (Univ., Parma, Italy). Riv. Ital. Stomatol.; 26: No. 11, 805-814 (Nov 1971). (In Italian).

Damages caused by x rays have been known for a long time because of the bad lesions they can bring about. Even though statistically not in great number, they represent a serious danger and have been looked into carefully. Dental surgeons were asked questions on the type of apparatus they use and on the number and way radiographs of patients are taken, so as to recommend all necessary precautions to prevent them. (auth)

7980 EFFECT OF C-G (HITHIOL CAPSULE) ON RADIOTOXEMIA. Huruta, A.; Nakada, J. (Kanto Rosai Hospital, Kawasaki, Japan). Shinryo To Shinyaku; 10: No. 3, 569-577(Mar 1973). (In Japanese).

C-G capsule was administered to the patients treated with a large quantity of remote cobalt irradiation, and its effect on symptoms of radiotoxemia was examined. One capsule of C-G containing 80 mg of cysteine and 120 mg of glucose within one capsule were administered three times a day and one capsule out of three was administered between meals. Symptoms of radiotoxemia such as total fatigue, nausea and vomiting, and anorexia were observed. Blood examination was carried out before irradiation, and after irradiation it was carried out once a week. The reported cases consist of 10 cases of breast cancer and its metastasis, four of brain neoplasms, three of penis neoplasms, two of uterus cancer (cervical uterus), two of larynx cancer, and one case each of maxilla cancer, tonsil cancer, parotid gland cancer, lung cancer, ovarian tumor, malignant lympadenoma, and chondrosarcoma. Six control subjects were used. Out of 28 cases, a dramatic response of the patients was recognized in five cases, an effective response in 19 cases, and an ineffective response in four cases. Two cases out of five that were treated with other preventives against radiotoxemia showed an ineffective response, and three cases showed effects thought to be potentiation. Especially, decrease of leukocytes was mild with prompt recovery. In the case of the chest and abdomen irradiation, four control subjects showed strong general radiotoxemia and marked decrease of leukocytes, and in the group administered C-G, one case discontinued irradiation. Moreover, symptoms, radiotherapy, radiotoxemia, and blood findings of the group administered C-G were also explained. (JA)

7981 INDUSTRIAL DERMATITIS: PRECAUTIONARY MEASURES. Health and Safety at Work Series, No. 18. London; Her Majesty's Stationary Office (1972). 15p. £0.12.

Industrial dermatitis, its causes, and the substances commonly responsible (mineral oils, chemicals, solvents and degreasers, tar, pitch and other coal tar products, radiations, etc.) are described. Preventive measures advised include: environmental protection (substitution of hazardous substances, enclosure and other means of limiting contact, good housekeeping, and removal of swarf from mineral oil); personal protection (the wearing of protective clothing, application of barrier substances to skin exposed to irritants, personal cleanliness, the use of skin cleansers and first aid); and supervision (the selection, inspection and education of those employed) and also scrutiny of measures and means provided for their protection. A list of relevant official publications is appended. (Occup. Saf. Health Abstr.)

7982 RADIATION AND PREGNANCY. Sternberg, J. (Univ. of Montreal). Can. Med. Ass. J.; 109: No. 1, 51-57 (7 Jul 1973).

A discussion is presented of irradiation during pregnancy, which may occur either as the result of radioactive pollution of the environment, or during medical procedures using x rays or radionuclides. While the former is usually unforeseeable, the latter is known and accepted by both physician and patient. Sources and levels of background radiation, and a mechanism of radiation damage are mentioned. Recent statistics estimate that about one quarter of pregnant women had a radiographic experience during the pregnancy, for obstetrical reasons or in the course of medical and dental examinations. The amount of radiation delivered to the fetus is in the range of one rad or less. Radionuclidic procedures may result in fetal radiocontamination, chiefly after placental transfer and fetal uptake. Radioiodine, radioactive calcium, and selenomethionine are dangerous for the fetus, since they cross the placenta freely and are taken up by fetal tissues. The labelled proteins, radiocolloids, and some mercury compounds remain in the maternal compartment and therefore can affect the fetus only through their gamma radiation at some distance from the fetus. The teratogenic effect, the leukemogenic threshold, and the lowered resistance to neonatal infections were demonstrated after irradiation with doses far higher than those encountered during diagnostic applications of ionizing radiation. Statistical data suggest an increase of susceptibility to leukemia in infancy after intra-uterine irradiation at a diagnostic level. Cytogenic analysis may offer valuable data for the establishment of the extent of radiation damage. It is concluded that there is no clear cut position for or against radiation procedures during pregnancy. (CA)

7983 DANGEROUS SUBSTANCES AND LEGISLATION. Buschmann, C. H. Veiligheid; 48: No. 3-5, 91-94; 131-134; 177-179(1972). (In Dutch).

An introduction on the increasingly widespread use of dangerous substances (flammable, explosive, corrosive, toxic, and radioactive) and on the enormous quantities of dangerous goods transported by land and sea, is followed by considerations of the

relevant Netherlands legislation and a table of laws applicable to different hazards. Individual sections are devoted to Netherlands and international regulations on dangerous goods transport and storage, and the procedure to be followed in the event of an accident. Estimation of hazard factors and the exact measurement of safety factors are reviewed. (Occup. Saf. Health Abstr.)

7984 FOUNDRY ENVIRONMENT CONTROL. Vol. 1. Control of Internal Foundry Environment. Des Plaines, IL; American Foundrymen's Society (1972). 306p. $80.00.

A profusely illustrated guide in loose-leaf form consisting of 12 Chapters devoted to: the visual environment (light and colour); heat stress and nonionizing radiation; foundry ventilation (general principles); exhaust systems and hood design; sandhandling systems; moulding, coremaking and patternmaking; melting and pouring; cleaning; maintenance and testing (fans, exhaust systems, etc.); industrial hygiene; ionizing radiation; noise control. (Occup. Saf. Health Abstr.)

7985 CHROMOSOME ABERRATIONS IN HUMAN BONE-MARROW CELLS AFTER A SINGLE LOCAL GAMMA IRRADIATION. II. Study of Dependence of Aberration Yield on the Dose. Pyatkin, E. K.; Petrova, S. A.; Suskov, I. I.; Alexandrov, N. N.; Vorobyev, A. I. (Inst. of Biophysics, Moscow). Stud. Biophys.; 33: No. 3, 184(1972).

Direct chromosome studies of bone-marrow cells were made in a control group of 14 tumor unirradiated patients and in a group of 67 patients 24 hrs after a single local irradiation with ^{60}Co gamma rays at doses of 50 to 500 rads. In the control group, aberrant cell frequency was 1.1% and chromosome break frequency was 0.01 per cell. In irradiated patients, single and paired fragments predominated among all aberrations independently of the dose. The mean frequencies of chromosome aberrations and breaks calculated per cell per unit dose in a dose-range of 50 to 300 rads were 0.00783 and 0.00892, respectively. It was shown that the yield of aberrant cells (Y) in a dose-range of 50 to 500 rads increases with the dose according to the equation $Y = 5.5\ 10^{-1}\ D^{0.84}$. (auth)

7986 REVIEW OF DETERMINATIONS OF RADIATION DOSE TO THE ACTIVE BONE MARROW FROM DIAGNOSTIC X-RAY EXAMINATIONS. Shleien, B. DHEW Publication (FDA) 74-8007. Rockville, MD; Department of Health, Education, and Welfare (1973). 26p. GPO $0.55.

The steps required for determination of the mean active bone marrow dose from diagnostic x rays and the procedures employed by investigators in making such determinations are reviewed in detail. In addition, a comparison is made of the results thus far obtained from all available studies. The purpose of this review of the literature is to provide background for planning additional determinations of active bone marrow doses. (auth)

7987 EXTERNAL EXPOSURE OF PERSONNEL AT THE INSTITUTE OF ISOTOPES OF THE HUNGARIAN ACADEMY OF SCIENCES DURING THE PERIOD 1963–1971. Tamas, B.; Martonne, B. pp 237-252 of Izotoptechnikai kutatasok. Budapest; A Magyar Tudomanyos Akademia Izotop Intezete (1972). (In Hungarian).

The film dosimetry service for the nine-year showed that the annual average dose of persons exposed to nuclear radiation remained in the range from 200 to 500 mR less than 10% of the human permissible dose. The average doses received in the expedition-room, where exposures were the highest, in no case exceeded 2 R per year. (auth)

7988 X RAY EXPOSURE IN CLOSED FEMORAL SHORTENING OSTEOTOMY. Fischer, S. (Hamburg Krankenhause, Bevensen, Ger.). Chirurg; 44: No. 4, 171-176(Apr 1973). (In German).

Shortening of the femur in closed operation technique is effected through an incision of the skin approximately 2 cms long and is performed by means of the intramedullary osteotomy developed by Küntscher, without having to open the site of osteotomy from outside. The whole procedure may be regarded as an advanced development of closed Küntscher nailing technique. This unorthodox operating technique would not be feasible without x-ray television, as the surgeon has to check the single operating steps on the T. V. monitor. For assessing radiation exposure the dose was measured during the operation performed with the aid of a mobile image intensifier unit. Whole-body exposure of the operating personnel was also measured. Results were as follows: Average incident dose is 50 R with occasional peaks of 100 R. The average area dose product is about 2000 R cm^2 which may be compared with the exposure occurring in fluoroscopy of the stomach. The gonad dose with male and female patients is about 150 mR and 70 mR, respectively. Whole-body exposure of the operating team and the operating personnel does under no circumstances exceed the legally tolerable limits. (auth)

7989 RADIOLOGICAL PROTECTION IN DENTISTRY. Holliday, B. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 5, 17-20(Oct 1973).

Attention is drawn to the lack of information available concerning the standards of radiation protection during dental radiography in the UK. Brief summaries are presented of three cases illustrating the type of hazards that might arise from faulty x-ray equipment or bad operating techniques. It is pointed out that the NRPB service to dentists offers a survey procedure designed to reduce or eleminate radiation exposures of patients. Data concerning beam size, quality, and duration of the x-ray exposure is obtained from a combined film and filted pack sent to the dentist, and this information is supplemented by a questionnaire. The results are assessed with reference to the Code of Practice for the Protection of Persons against Ionizing Radiations arising from Medical and Dental Use. (UK)

7990 CHANGES IN FREQUENCY OF CHROMOSOME ABERRATIONS OF HUMAN PERIPHERAL LYMPHOCYTES DURING THE COURSE OF FRACTIONATED RADIOTHERAPY IN CERVICAL CANCER, EMPHASIS ON THE LYMPHOCYTE KINETICS. Tamura, H. (Kyoto Univ.). Nippon Sanka Fujinka Gakkai Zasshi; 25: No. 1, 10-18(Jan 1973). (In Japanese).

The relationship between numbers of radiation therapy and frequency of chromosome aberrations was investigated by studying chromosomes in the peripheral lymphocytes during the course of radiotherapy in patients with uterine cancer. Heteroploidy cells rapidly increased after the 1st or the 2nd irradiation, and after then they were constant. There was no evident relationship between the number of 4-fold somatic cells and that of the cells with chromatid-type aberration. The number of the cells with unstable chromosome aberrations increased linearly until the 5th irradiation. However, the number was constant between the 6th irradiation and the 10th irradiation, and then it showed a tendency to increase again. In addition, the distribution in the number of dicentrics per cell was well similar to that of poisson. The number of peripheral lymphocytes began to decrease rapidly after the 7th irradiation. After then, it was constant, and again decreased with numbers of irradiation. From these results, it is hypothesized that lymphocytes in the peripheral blood and general lymphatic histiocytes are interchanged at intervals of about one hour. (JA)

7991 RADIATION THERAPY OF CARCINOMA OF THE MAXILLARY ANTRUM. Matsuura, S.; Taketa, C.; Ono, I.; Ebihara, S. (National Cancer Center, Tokyo). Gan No Rinsho; 19: No. 6, 577-581(Jun 1973). (In Japanese).

The total number of 187 cases with carcinoma of the maxillary antrum treated at National Cancer Center from 1962 to 1971 were divided into two groups. Group A (1962 to 1966) consisted of 90 cases, of which 72.2% received mainly radiotherapy with dose over 6000 rad. Group B (1967 to 1972) consisted of 97 cases, of which patients irradiated with over 6000 rad was 21.6% and intraarterial infusion of 5-FU was combined. As the injuries after irradiation, 48 cases developed radiation cataract. Advanced disturbances of visual acuity by cataract was caused by the radiation with over 4000 rad in about two-thirds of them within 2 yrs and in one third within 3 to 5 yrs. In 13 patients with shielding of the eyeball from the beginning, no complications of the eyes were found except in one patient. In the injuries of the bone and the soft tissue, the fragments of the bones irradiated with high doses were easily infected and were incurable when osteomyelitis was complicated. Five cases in the over-5-year survival cases showed third-degree injuries of the tissue from external irradiation with over 6000 rad. The 3-year crude survival rate of A and B group was 51.6 and 46.0% respectively, and the 5-year crude survival rate in the whole was 42.2%. Adequate combination of radiotherapy, intraarterial infusion for chemotherapy, and surgery are now under study. At present, the dose of 5-Fu was tentatively determined at 3000 mg and the radiation was 4000 rad. For the improvement of therapeutic results, programmings with plans of radiotherapy of each case and the managements of the detailed information on personal history are now under preparation as a radiotherapy using electric computer. (JA)

7992 LUNG CANCER RISK BY INHALATION OF ^{222}Rn DECAY PRODUCTS. Jacobi, W. (Gesellschaft fuer Strahlen- und Umweltforschung mbH., Nuremberg). Biophysik; 10: No. 2, 103-114(1973). (In German).

The results of surveys in the USA and the CSSR on the lung cancer mortality among uranium miners are compared. The relation between the observed excess lung cancer mortality and the cumulative exposure of these miners by inhaled Rn-daughters is discussed and the risk coefficients for radiation-induced lung cancer are estimated. The relative risk coefficients of both

study groups of U-miners agree within the confidence limits and are in the range of 0.001 to 0.005 WLM^{-1}. The derived absolute risk coefficients of 20 ± 10 (USA group) and 150 ± 50 (CSSR group) additional lung cancer deaths per WLM and 10^6 miners are, however, significantly different. The influence of synergistic or cocancerogenic actions is discussed. The increase of lung cancer mortality with Rn-exposure is significantly correlated with an increase of the small-cell, undifferentiated type of carcinoma. (auth)

7993 EFFECTS ON PARARADIOLOGICAL AND POST-IRRADIATION DYSBACTERIA AND ON INTESTINAL RADIOREACTION CAUSED BY BIFIDUS BACTERIA REPLACEMENT THERAPY. Mettler, L.; Romeyke, A.; Brieler, G. (Univ., Kiel). Strahlentherapie; 145: No. 5, 588-599(1973). (In German).

In a group of 40 patients with colon carcinoma, the frequency of enterocolitis and diarrhea occurring during and after radiation, with and without substitution of vital bifidus bacteria, was investigated. A quantitative bacteriological analysis of the feces was performed, considering the biological criteria of the different bacterial strains. The results indicated that radiation therapy is correlated with a decrease of the majority of the bacteria found in the intestinal flora. Patients treated with bactobacillus bifidus showed 30% diarrhea, while 65% of a control-group had diarrhea. As compared to a control-group under the bacterial substitution, a significant increase of the number of bactobacillus bifidus bacteria was observed. (GE)

Vertebrates

Refer also to abstracts 7896, 7899, 7908, 7914, 7917, 7921, and 8081.

7994 (JPRS-59702, pp 36-41) MORPHOLOGICAL AND ELECTRON MICROSCOPE CHANGES IN THE CARDIAC MUSCLE OF DOGS EXPOSED TO CHRONIC GAMMA IRRADIATION. Bespalova, L. A. 1973. Translated from Kosm. Biol. Med.; 7: No. 3, 26-30(1973).

In Space Biology and Medicine, Vol. 7, No. 3, 1973.

A group of dogs was exposed to chronic ^{60}Co γ irradiation in doses of 21, 63, 120, 125, and 190 rad per year. At the same time, another group of dogs was exposed to chronic three-year irradiation with a total dosage of 560 rad and was treated specifically. A light optic study of the myocardium of these dogs revealed no pathological changes in the muscle fibers, stroma, or intramural vessels. An electron microscope study of the myocardium revealed insignificant changes in the cell ultrastructure only in the dogs exposed to 190 rad per year and 560 rad per three years. These changes included high polymorphism of mitochondria and lysosomes. The number of lysosomes increased. Endothelial cells of capillaries exhibited enhanced micropinocytosis. (auth)

7995 (JPRS-60471, pp 31-38) STATE OF NATURAL IMMUNITY OF DOGS EXPOSED TO CHRONIC GAMMA IRRADIATION. Shilov, V. M.; Pal'mina, S. I.; Markelov, B. A. 1973. Translated from Kosm. Biol. Med.; 7: No. 5, 23-28(1973).

The results of a study of the natural immunity of dogs exposed to three-year chronic gamma irradiation are presented. The relationship between changes in the humoral and cellular factors of natural immunity and the irradiation dose was established. The animals irradiated in a dose of 21 rad per year exhibited activation of the complementary and bactericidal properties of the blood. The dogs irradiated in doses of 125 rad and 62 + 125 rad per year exhibited changes in immunological reactivity which adhered to certain phases: stimulation was accompanied by a marked decline. These findings give evidence of large compensatory capabilities of the animal body during chronic exposure to ionizing radiation. (JPRS)

7996 (ORNL-EMIC-5) CHEMICAL MUTAGENESIS IN LABORATORY MAMMALS. A Bibliography on the Effects of Chemicals on Germ Cells. Von Halle, E. S. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Sep 1973. 69p. Dep. NTIS $5.50.

A list of references is presented on chemical mutagenesis in laboratory mammals. The references relate primarily to chemical effects on germ cells. Only references to the use of chemicals or chemicals and radiation are included. The publication includes a citation index, agent index, chemical abstracts registry number index, organism index, KWIC index, author index, and first author index. (ERB)

7997 LIFE SCIENCES AND SPACE RESEARCH X. Proceedings of the Open Meeting of Working Group 5 of the Fourteenth Plenary Meeting of COSPAR, Seattle, Washington, June 21–July 2, 1971. Vishniac, W. (ed.). Berlin; Akademie-Verlag (1972). 235p. (CONF-710615-).

From 14th COSPAR meeting on life sciences and space research X; Seattle, Washington, USA (17 Jun 1971).

Separate abstracts were prepared for 7 of the 27 papers appearing in these proceedings. The other papers discuss topics in the following general areas: planetary quarantine; effects of weightlessness, effects of space on living matter; and preparations for the exploration of Mars. (ERB)

For abstracts of individual papers see: 7922–7924 and 7998–8001.

7998 PHYSIOLOGICAL AND HEMATOLOGICAL EFFECTS OF CHRONIC IRRADIATION. Grigorev, Yu. G.; Markelov, B. A.; Popov, V. I.; Akhunov, A. A.; Tsessarskaya, T. P.; Ilyukhin, A. V.; Fyodorova, N. L.; Burkovskaya, T. E.; Shafirkin, A. V. (Inst. of Medical and Biological Problems, Moscow). pp 147-154 of Life Sciences and Space Research X. Vishniac, W. (ed.). Berlin; Akademie Verlag (1972).

From 14th COSPAR meeting on life sciences and space research X; Seattle, Washington, USA (17 Jun 1971). See CONF-710615-.

The information available for assessing radiation hazard involved in prolonged space missions is so far insufficient. Therefore, a three-year experiment was carried out in which 180 dogs were exposed to irradiation, simulating the dose value and rate of exposure that may occur in a real space flight of long duration. The exposure included a chronic irradiation (with dose rates of 21, 62, and 125 rads/year) and a combined irradiation during which the animals were exposed to chronic and acute irradiations with a dose of 8 or 42 rads applied three times every year, the annual total dose being 120 or 188 rads, respectively. Insignificant hematopoietic changes, e.g. the ratio of red to white blood cells, their decrease in the peripheral blood, were found. Distinct changes in the reproductive function were noted. The general condition of the animals was satisfactory. Most animals endured well an additional physical load and retained conditioned reflexes developed before irradiation. The experimental findings suggest that the effects are early symptoms of the first stage of chronic radiation damage. (auth)

7999 EFFECTS OF DOSE PROTRACTION ON HEMATOPOIESIS IN THE PRIMATE AND DOG. Spalding, J. F.; Holland, L. M.; Prine, J. R. (Los Alamos Scientific Lab., NM). pp 155-164 of Life Sciences and Space Research X. Vishniac, W. (ed.). Berlin; Akademie-Verlag (1972).

From 14th COSPAR meeting on life sciences and space research X; Seattle, Washington, USA (17 Jun 1971). See CONF-710615-.

The modifying effects of dose protraction by fractionation or continuous low dose-rate exposure are not well known in the primate. Comparative studies between the two mammalian species dog and monkey with widely differing acute LD_{50} values have not been made. A program to study dose-rate effects on injury and recovery of the bone marrow in dogs and monkeys under simultaneous and similar exposure conditions is in progress. The equivalent residual dose (ERD) assumptions of 10% irreparable injury and a 28-day recovery half-time for the reparable portion (90%) of radiation were studied in dogs (beagles) and monkeys (Macaca arctoides) using variable recovery times and appropriate fractionated exposures to attain but not exceed theoretical effective residual body burdens of 200 rads over a 1-year period. The ERD assumptions were tolerated by the dogs but resulted in death to 7 of 8 monkeys tested. The same ERD assumptions were tested with monkeys (Macaca mulatta) using a fixed recovery time span and an upper ERD limit of 100 rads. Monkeys in this study have tolerated 1900 rads of gamma-ray exposure (approximately three times the acute lethal dose) with minimal suppression of the hematopoietic system. (auth)

8000 SUMMARY OF LATENT EFFECTS IN LONG TERM SURVIVORS OF WHOLE-BODY IRRADIATIONS IN PRIMATES. Kirk, J. H.; Casey, H. W.; Traynor, J. E. (School of Aerospace Medicine, Brooks AFB, TX). pp 165-173 of Life Sciences and Space Research X. Vishniac, W. (ed.). Berlin; Akademie-Verlag (1972).

From 14th COSPAR meeting on life sciences and space research X; Seattle, Washington, USA (17 Jun 1971). See CONF-710615-.

The USAF School of Aerospace Medicine, Radiobiology Division, Brooks Air Force Base, Texas presently is maintaining a colony of over 450 primates in which the whole body has been exposed to various types of space radiation including protons and electrons. The majority of the primates (Macaca mulatta) were exposed during 1965. Types of radiation involved are 2-MeV x rays, 5-MeV to 2.3-GeV protons, and 1.6-MeV electrons. Low-energy proton dose range up to 3000 rad (50 to 100 rad min^{-1}) whereas the penetrating-energy doses range up to 700 rad (15 to 100 rad min^{-1}). Primates from a simulated solar flare exposure are also included. In late 1970, a small group of primates exposed to 108- and 85-MeV alpha particles (eye and partial body only) were added to the colony. Data are available in the following areas: chronic skin

changes; testicular atrophy; cataractogenesis; hematological and serum biochemical analysis; incidence of tumors; causes of death; body weight variations; and summary of alpha particle experiences. (auth)

8001 ANALYSIS OF SURVIVAL AND CAUSE OF DEATH STATISTICS FOR MICE UNDER SINGLE AND DURATION-OF-LIFE GAMMA IRRADIATION. Grahn, D.; Fry, R. J. M.; Lea, R. A. (Argonne National Lab., IL). pp 175-186 of Life Sciences and Space Research X. Vishniac, W. (ed.). Berlin; Akademie-Verlag (1972).

From 14th COSPAR meeting on life sciences and space research X; Seattle, Washington, USA (17 Jun 1971). See CONF-710615-.

The late effects of protracted exposure to low levels of external radiation continue to be a matter of operational concern in long-range space flight. Studies were carried out on young adult mice exposed to daily levels of ^{60}Co gamma irradiation ranging from 0.3 to over 30 R day^{-1}. The lowest level is comparable with the occupational maximum permissible dose for the atomic energy industry. There is little evidence of life shortening at that level, but as exposure increases, there is an exponential decline in life expectancy. The life-shortening coefficient is approximately 4 days/100 R accumulated or 4% R^{-1} day^{-1}. When life-shortening is ≤ 15%, all of the increased mortality can be attributed to radiation-induced increases in death rates from neoplastic diseases, including various forms of leukemia and pulmonary tumors. Age-specific death rates for mice dying of all other causes remain the same as the controls throughout life, at the lowest doses. A non-neoplastic disease component of excess mortality rate emerges at 6 R day^{-1} and above. The risk of death from all and specific causes following single exposures compared with protracted lifetime irradiation shows a clear effect of protraction. Leukemia death rates are reduced by a factor of 5 or more at all daily exposure levels below 20 to 30 R day^{-1}. Risks for other causes of death are also reduced, but to a variable degree. (auth)

8002 RECOVERY EFFECT OF POLYRIBONUCLEOTIDIC ACIDS AND POLYVINYLSULFATE ON IRRADIATED BONE MARROW STEM CELLS. Ekert, B.; Monnot, P.; Duplan, J. F. Compt. Rend., Ser. D; 276: No. 22, 2981-2983(28 May 1973). (In French).

Polyribo-cytidylic and uridylic acids possess recovery properties; such properties are not very significant for polyriboadenylic acid and nonexistent for polyriboguanylic acid. A correlation is apparent between the recovery activity of these acids and their affinity for nucleases, this fact being confirmed by the very large recovery effect produced by polyvinylsulfate, a specific nuclease inhibitor. It is thus feasible to envisage that the recovery due to PRNA occurs through the competitive inhibition of the degradation of cell RNA by irradiation activated nucleases. (FR)

8003 EFFECTS OF X IRRADIATION ON THE EARLY STAGES OF THE MEMORY SYSTEM IN RATS. Gould, M. N.; Yatvin, M. B. (Univ. of Wisconsin, Madison). Physiol. Behav.; 11: No. 2, 177-179(Aug 1973).

It was previously demonstrated that late stages of the memory system are radioresistant. In the present study early-stage radiosensitivity was investigated in rats. The animals were given dark avoidance training by a one-trial method employing electric shock as the unconditioned stimulus. Then they were either exposed to 2000 R of whole body x irradiation or sham irradiated. When the rats were tested 24 hr later, no difference could be detected between these groups. Based on the data from these experiments, the early stages of the memory system appear to be relatively radioresistant. (auth)

8004 EFFECTS OF IRRADIATION AND/OR HANDLING ON SHUTTLE BOX PERFORMANCE OF C57B1/6 MICE. Sherrod, K. B. (Vanderbilt Univ., Nashville). Physiol. Behav.; 10: No. 4, 721-724(Apr 1973).

Twenty C57B1/6 primigravida females were irradiated at 0.1 R/hr for 15 days of gestation (36R total) and 20 were sham irradiated. The offspring were cross-fostered to sham irradiated or irradiated dams, resulting in 4 groups of 10 litters each, 0.1R/0.1R,S/0.1R,0.1R/S, and S/S. Half of the infants in each group were handled on postpartum days 3 to 12. On days 30 and 60 the offspring were given 30 trials in a 2-way shuttle box avoidance apparatus. Although irradiation was predicted to enhance learning, irradiation of the infant tended to depress learning on day 30 and particularly on day 60. This effect could have been due to the early age at which the first trials were given or to the low irradiation level used. Effects of irradiation are hypothesized to be nonmonotonic from 0 to 200 to 300+ R. The importance of finding any effects following chronic administration of such low levels of irradiation was noted. Handling had no effect on shuttle box behavior. (auth)

8005 CHANGES IN THE WAKING-SLEEPING BEHAVIOR AFTER ALBUMIN OR γ GLOBULIN INJECTION TO LETHALLY IRRADIATED RATS. Maigrot, J. C.; Cier, A.; Riotte, M.; Philibert, H. (Centre de Recherches du Service de Sante des Armees, Lyon). Compt. Rend. Soc. Biol.; 167: No. 1, 45-50 (1973). (In French).

Studies were performed on chronically implanted rats. These rats were subjected to whole-body irradiations of 950 rads (LD 100% 6 days). The following reproducible changes were observed: serious nonreversible disturbances in the waking-sleeping behavior, manifested principally by an almost complete disappearance of paradoxical sleep 4 days after the exposure. The intraperitoneal administration, 4 to 5 days after irradiation of one or several 250mg doses of γ-globulin enabled the rats to recover both quantitatively and qualitatively a paradoxical sleep identical to that observed with nonirradiated animals during 2 to 3 days. On the other hand when γ globulins are injected into nonirradiated animals, the PS level does not alter in any significant way. In addition, injections of human albumin serum carried out under the same experimental conditions, appear to modify EEG parameters, which have been disturbed by irradiation as well as producing a significant improvement in the general state of the irradiated animal, this being confirmed by the prolonged survival time observed. (FR)

8006 SPECIFICITY OF BIOCHEMICAL CHANGES OBSERVED AFTER ADMINISTRATION OF RADIOPROTECTIVE AMINOTHIOLS. Sheremet'vskaya, T. N.; Filippovich, L. V.; Romantsev, E. F. (Inst. of Biophysics, Moscow). Vop. Med. Khim.; 19: No. 5, 523-527(1973). (In Russian).

The role of mixed-disulfide bonds in the inhibitory effect of cysteine and isocysteine on the thymidine kinase activity from the thymus and spleen of rats was investigated. In experiments with sulfur-containing protectors (MEA, cysteine) only a correlation was demonstrated between doses of the administered preparations, their inhibitory effect on the thymidine kinase activity and their ability to form mixed-disulfide bonds with proteins. Comparison of these results with the data on survival of the x-ray treated animals, which received prophilactic doses of the protectors, suggested that there was a correlation between these values. (auth)

8007 EFFECT OF IONIZING RADIATION ON PROTEIN SYNTHESIS IN LACTATING MAMMARY GLANDS. Ivanov, I. I.; Rudakov, V. V. (Military Medical Academy, Leningrad). Vop. Med. Khim.; 19: No. 5, 475-477(1973). (In Russian).

X-irradiation (up to 5000 R) of the mammary gland did not impair within the first hours after irradiation the synthesis of proteins during lactation. These data suggested that the protein synthesis system that functioned to the beginning of the irradiation exhibited considerable radioresistance. The synthesis of soluble proteins was markedly inhibited in mammary gland within the period of pronounced symptoms of radiation syndrome caused by x-ray treatment (900 to 1200 R). This phenomenon was probably due to the fact that the m-RNA molecules synthesized before the x-ray treatment were degraded while the formation of new m-RNA molecules was prevented by damage of DNA caused by the ionizing radiation. (auth)

8008 ATTEMPTED LATENTIATION OF 2-ACETAMIDOETHANETHIOL WITH α,β-UNSATURATED ACIDS. Srivastava, P. K.; Field, L. (Vanderbilt Univ., Nashville). J. Med. Chem.; 16: No. 4, 428-429(Apr 1973).

For several years we have been interested in synthesis of compounds that would modify radioprotective thiols in such a way as to reduce their toxicity and/or improve their activity. Essentially, this approach has been one of latentiation. Latentiation of a drug may provide a means of favorably influencing absorption, transport, distribution, localization, metabolism, and toxicity, as well as stability. Hopefully, a radioprotective thiol affords a valid model for developing principles of latentiation applicable to any medicinally significant thiol. The use of maleic and cinnamic acids for latentiating 2-acetamidoethanethiol by reaction with the thiol function is described. (auth)

8009 ANTIRADIATION AGENTS. 3-[(Alkylthio)alkyl]-thiazolidines and Substituted 2-({[(3-Thiazolidinyl)alkyl]thio)pyridines and -Quinolines. Westland, R. D. (Parke, Davis and Co., Ann Arbor, MI); Lin, M. H.; Cooley, R. A. Jr.; Zwiesler, M. L.; Grenan, M. M. J. Med. Chem.; 16: No. 4, 328-331(Apr 1973).

5-Halo- and 3,5-dihalo-2-{[(3-thiazolidinyl)alkyl] thio}pyridine hydrochlorides [alkyl = $(CH_2)_{3-8,10}$] and substituted and unsubstituted 2-{[(3-thiazolidinyl)alkyl]thio}quinoline hydrochlorides [alkyl = $(CH_2)_{3,4}$] were prepared by alkylation of 2(1H)-pyridinethiones and 2(1H)-quinolinethiones with 3-(chloroalkyl)thiazolidines. The series was extended to 3-[(alkylthio)alkyl]thiazolidine hydrochlorides $[CH_3(CH_2)_{n_1}\text{-}S\text{-}(CH_2)_{n_2}$, involving 27 combinations of n_1 = 0-9 and n_2 = 2-7] by alkylation of alkanethiols. Several compounds exhibited promising antiradiation activity, either by ip or po administration. Generally the compounds were more

active in the po test. 5-Chloro-2-{[7-(3-thiazolidinyl)heptyl]thio}-pyridine hydrochloride given po at 75 mg/kg (ca 0.13 LD_{50}) afforded 60% survival in the 30-day test. 3-[5-(Pentylthio)pentyl]-thiazolidine hydrochloride resulted in 92% survival (30-day) of the mice when given po at 125 mg/kg (0.2 LD_{50}). (auth)

8010 ANTIRADIATION AGENTS. Substituted 2-Pyridyloxy and 2-Quinolyloxy Derivatives of S-2-(Alkylamino)Ethyl Hydrogen Thiosulfates and 3-Alkylthiazolidines and Substituted 2-Pyridyloxy Derivatives of 2-(Alkylamino)Ethanethiols and Corresponding Disulfides. Westland, R. D. (Parke, Davis and Co., Ann Arbor, MI); Cooley, R. A. Jr.; Holmes, J. L.; Hong, J. S.; Lin, M. H.; Zwiesler, M. L.; Grenan, M. M. J. Med. Chem.; 16: No. 4, 319-327(Apr 1973).

Substituted 2-pyridyloxy and 2-quinolyloxy derivatives of S-2-(alkylamino)ethyl hydrogen thiosulfates, 3-alkylthiazolidines, and substituted 2-pyridyloxy derivatives of 2-(alkylamino)ethanethiols and corresponding disulfides were synthesized as antiradiation agents by the appropriate aziridine ring-opening reactions of substituted 2-{[(1-aziridinyl)alkyl]oxy}pyridines and -quinolines. 5-Substituted 2-chloropyridines and substituted 2-chloroquinolines were prepared for heterocyclic ether-forming reactions by treatment with the Na salts of 1-aziridinealkanols to give the aziridinylalkyloxy derivatives. 5-Halo-2-pyridyl ethers resulted in the highest antiradiation activity regardless of route of administration or type of sulfur-co[illegible]ing group. S-2-({5-[(5-Chloro-2-pyridyl)-oxy]-pentyl}amino)ethyl hydrogen thiosulfate and S-2-({5-[(3,5-dichloro-2-pyridyl)oxy]pentyl}amino)ethyl hydrogen thiosulfate afforded 87% survival of mice in the 30-day test at 19 ($^1/_{12}$ of LD_{50} dose) and 12.5 mg/kg ip ($^1/_{14}$ of LD_{50} dose), respectively. In view of the dearth of agents effective perorally, remarkably good radioprotection was found on oral administration of thiazolidines substituted in the 3 position with 5-halo-2-pyridyloxypentyl or -hexyl groups; 5-chloro- and 5-iodo-2-{[6-(3-thiazolidinyl)hexyl]oxy}pyridine hydrochlorides resulted in survival rates of 73% at 150 mg/kg po (0.25 of LD_{50} dose) and 93% at 300 mg/kg po (0.5 of LD_{50} dose), respectively. (auth)

8011 INHIBITION BY PROGESTERONE OF RADIATION-ESTROGEN-INDUCED MAMMARY CANCER IN THE RAT. Segaloff, A. (Alton Ochsner Medical Foundation, New Orleans). Cancer Res.; 33: No. 5, 1136-1137(May 1973).

The data from this preliminary experiment make it appear that continuous administration of progesterone protects animals from the synergism between estrogen and radiation. However, it also appears that the progesterone has by itself a protective effect against the individual carcinogenic agents since fewer tumors occurred on the opposite side as well as on the radiated side. In this preliminary experiment none of the animals that bore just progesterone pellets and were radiated developed mammary carcinomata. (auth)

8012 INFLUENCE OF AGE ON THE RESPONSE OF RAT STEM SPERMATOGONIA TO γ RADIATION. Erickson, B. H.; Martin, P. B. (Oak Ridge National Lab., TN). Biol. Reprod.; 8: 607-612(Jun 1973).

Testes of Sprague–Dawley rats aged either 2 to 12 months were administered 285 rads of ^{60}Co γ radiation at 45 rads/min. Irradiated animals along with controls (10 per group) were killed at postirradiation intervals varying from 5 to 120 days. Irradiation effects were assayed through testicular weights and counts of type-A spermatogonia in 50 cross sections of seminiferous tubules at stages 5 to 8 of the spermatogenic cycle. No significant difference in number of type-A spermatogonia was observed in testes of nonirradiated rats between the ages of 2 and 16 months. Irradiation reduced spermatogonial numbers to 21 to 25% of control in both age groups, but the postirradiation interval at which it occurred was different–day 5, 2 months; day 10, 12 months. By 24 days after irradiation, spermatogonial numbers had increased to 55% of control in 2-month testes, but 12-month testes were only at 40% of control. The magnitude of the difference between young and old did not change at later postirradiation stages. At 80 days after irradiation, spermatogonial numbers peaked at 90% of control in 2-month testes and 74% of control in 12-month testes. Percents of control at 120 days postirradiation were 84 and 70% for 2- and 12-month testes, respectively. These results lead to the conclusion that irradiation produces a permanent decrement in the stem spermatogonial population with the magnitude of the decrement being age dependent. (auth)

8013 DEFENSE OF CUTANEOUS CELLS AGAINST UV IRRADIATION. II. Restricted Photomediated Binding of Trimethylpsoralen to Pigmented Skin in Vivo. Carter, D. M.; Jegasothy, B. V.; Condit, E. S. (Yale Univ., New Haven). J. Invest. Dermatol.; 60: No. 5, 274-277(May 1973).

Distinct differences in grain distribution were seen in autoradiographs of pigmented and nonpigmented skin from spotted guinea-pig ears subjected to photosensitizing conditions by the topical application of tritiated trimethylpsoralen (^3H-TMP) and exposure to uv irradiation at 365 nm. Grains were localized over cells throughout the epidermis in nonpigmented skin, but they were not seen beneath the stratum corneum in pigmented skin. Since TMP covalently binds to epidermal nucleic acids only after irradiation, these experiments demonstrate that the compacted melanized cells of the outer epidermis shield the DNA of underlying cells by severely restricting the penetration of uv light into the skin. (auth)

8014 EFFECT OF TOTAL BODY X IRRADIATION ON ACTIVITY OF TRANSAMINASES IN BLOOD SERUM AND SUBCELLULAR FRACTIONS OF RABBIT LIVER. Savits'kii, V. I. (Medical Inst., Odessa). Ukr. Biokhim. Zh.; 45: No. 4, 462-465 (1973). (In Ukrainian).

The total x-ray irradiation in a dose of 450 R evokes essential phase changes in dynamics of aspartate-aminotransferase (AST) and alanine-aminotransferase (ALT) activities. Peculiarities of these deviations are pronounced in time of appearance, direction, depth (degree), and duration of the changes in the activity of the enzymes under study as dependent on the tissue and subcellular localization. The primary tendency in the ASTase activity change is its intensification of ALT–relaxation. The ASTase activity in hyaloplasm is particularly intensified during the first hours and on the 15th and 30th day after irradiation and in the mitochondria at the end of the first and fifth day. (auth)

8015 INFLUENCE OF SUB-LETHAL DOSES OF X RADIATION ON THE FLUORESCENCE OF LEUKOCYTES NUCLEI IN EXPERIMENTAL ANIMALS. II. Changes in the Relative Values of Leukocytes with Green Fluorescence of the Nuclei Following a Repeated Total-body Irradiation with 25, 50, and 100 R. Kolesar, D. (Komenskeho Univ., Bratislava). Bratislav. Lek. Listy; 59: No. 5, 531-538(May 1973). (In Czech).

Repeated irradiation of white rats by sub-lethal doses of 25, 50, and 100 R following a 14-day interval between the application of the first and the second dose produces a marked decrease in the relative values of the granulocytes with green fluorescence of the nuclei. The largest decrease was again observed at 24 hrs following the irradiation, and it was dependent on the amount of the applied dose. Following a repeated dose of 25 R it was on an average 6.7%, following a 50 R dose it was 15.4%, and following 100 R it was 21%. To a lesser extent, there was also observed a marked decrease in the relative values of the granulocytes with green fluorescence of the nuclei. For judging the relationship between the dose and the biological response a more suitable index remains the decrease in the relative values in the granulocytary order than in the agranulocytary order. Judging the changes in the fluorescence of the nuclei of granulocytes, it may be concluded that under the given conditions, a 14-day interval between the first and the second irradiation is not sufficient in order that the strengthening effect of the repeated irradiation may not be manifested, which in itself excludes the possibility of radioresistance under these conditions. (auth)

8016 CYTOSPECTROPHOTOMETRICAL AND MORPHOLOGICAL DATA ON THE EFFECT OF IONIZING RADIATION ON THE MAMMARY GLAND. Rudakov, V. V.; Shavlaev, Z. F. Arkh. Anat., Gistol. Embriol.; 53: No. 10, 21-27(Oct 1972). (In Russian).

Morphological picture of the lactating mammary glands was studied in goats and albino rats under normal conditions and after irradiation. The RNA and protein contents were determined cytospectrophotometrically in the glandular cells after exposure to ionizing radiation. No changes were found in the general structure of the gland in goats within the first hours after local irradiation of the gland at 5000 R. The RNA content was not considerably changed, but the amount of protein increased considerably. During radiation disease resulting from general irradiation of rate (1000 R) the morphology of the mammary gland had pronounced lesions: destruction and degeneration of cells, alveoli, and glandular lobes. The RNA content in the cell decreased. The data obtained show no lesions in the cell structure responsible for protein biosynthesis immediately after irradiation. The changes observed during radiation disease seem to be secondary. (auth)

8017 STIMULATION OF GROWTH OF METASTASES BY LOCAL X IRRADIATION IN KIDNEY AND LIVER. van den Brenk, H. A. S.; Kelly, H. (Saint Thomas Hospital, London). Brit. J. Cancer; 28: No. 4, 349-353(Oct 1973).

One kidney and the adjacent liver in a group of rats were locally irradiated with a single x-ray dose of 1000 rad 7 days before intravenous injection of 10^5 Y-P388 tumor cells. A day before this injection all rats were given 0.5ml of heterologous rabbit anti-rat lymphocytic serum (ALS), to suppress immunity to tumor growth, and increase colony forming efficiency (CFE). In another group, the right or left kidney was irradiated, but the rats received no

ALS and the number of tumor cells was increased to 5×10^5. Over 200 tumor colonies formed in the lungs of every rat given ALS, causing marked increase in lung weight. In the 13 rats not given ALS but more tumor cells, there were fewer colonies. In 15 of the 16 rats, colonies were more numerous on the surface of the irradiated kidney after ALS treatment and in 11 of the 13 rats not given ALS colony counts were generally higher in the younger rats. Colonies, which were noticeably larger in the irradiated kidneys, appeared to be restricted to the renal cortex. Tumor macrocolonies had developed in the liver and were more numerous and larger in the irradiated part of the organ, but otherwise similar in appearance and histological structure. The colonies appeared to be distributed uniformly throughout the organ and to have diginated in the portal tracts at the periphery of liver lobules. Scattered colonies had grown under the surfaces of the gastrointestinal tract, mesenteries, and bladder, being more numerous after ALS treatment. (UK)

8018 EFFECTS OF HYDROCORTISONE TREATMENT AND WHOLE-BODY IRRADIATION ON MOUSE LYMPHOCYTE STIMULATION IN VITRO. Ruehl, H.; Vogt, W.; Ruehl, U.; Bochert, G.; Schmidt, S. (Freie Univ., Berlin). Immunology; 25: No. 5, 753-760(Nov 1973).

Whole-body γ irradiation was found to reduce the number of nucleated cells in the thymus and the spleen of C57B1 mice to the same extent as hydrocortisone treatment. Equal numbers of thymus and spleen cells from either hydrocortisone-treated or irradiated mice (dose-range 50 to 400 rads), and matched controls were cultured and stimulated with various mitogens. An increased stimulation of DNA synthesis by PHA, Con A, and PWM was found in thymus and spleen cells after hydrocortisone treatment as well as after whole-body irradiation. In contrast, the response to LPS, known as a typical B-cell mitogen, was not affected by any of the procedures. (auth)

8019 ACTIVATION OF LYMPHOID LEUCOSIS IN CHICKS BY IRRADIATION. Lagerloef, B. (Karolinska Sjukhuset, Stockholm); Mares, I. Acta Pathol. Microbiol. Scand., Sect. A; 81: 569-576(1973).

Two strains of commercially bred chicks (White Leghorn and Babcock), and one strain of leucosis-free chicks (White Leghorn-SPAFAS) were treated with whole-body irradiation. This treatment enhanced the incidence of lymphoid leucosis in the commercially bred animals; with the highest dose of irradiation employed (300 rad × 4), 20 per cent of the Babcock chicks developed lymphoid leucosis after a latent period of 161 to 357 days, whereas none of the irradiated SPAFAS chicks that were kept in strict isolation during the whole experimental period developed leucosis. One out of eight SPAFAS chicks kept in contact with leucosis-carrying chicks developed lymphoid leucosis. The disease was transmissible to other non-irradiated chicks with cell-free material. Whole-body irradiation is considered to have a complex effect with possible activation of latent avian tumor virus. The possibility of induction of virus production in leucosis-free chicks is discussed. (auth)

8020 CHANGES IN THE INTENSITY OF ULTRAVIOLET FLUORESCENCE OF LEUKOCYTES OF DOGS EXPOSED TO CHRONIC IRRADIATION. Aleksandrov, S. N.; Safronova, V. G.; Yagunov, A. S. Kosm. Biol. Med.; 7: No. 6, 27-31(1973). (In Russian).

The intensity of ultraviolet fluorescence of lymphocytes and neutrophils of dogs exposed to chronic gamma irradiation (at a dose rate of 0.06, 0.17, and 0.34 rads/day) was studied. The intensity of ultraviolet fluorescence increased gradually at doses of 0 to 70 rads. The intensity remained at a constant level that was significantly higher than the control at doses of 70 to 300 rads. The intensity decreased with a further increase of the dose. It is suggested that the decline of the fluorescence level of blood leukocytes is associated with the emergence in bone marrow of radioresistant cells producing leukocytes with a normal fluorescence intensity. This parameter was high at every dose tested (up to 740 rads) upon a combined effect of chronic irradiation (62 rads per year) and acute irradiation (42 rads three times a year). (auth)

8021 EFFECT OF THE PATTERN OF THE ABSORBED DOSE DISTRIBUTION ON THE RADIATION DAMAGE. Avetisov, G. M.; Budylin, V. N.; Gorlov, V. G.; Grammatikati, V. S. Kosm. Biol. Med.; 7: No. 6, 19-26(1973). (In Russian).

The effect of the damage of a bilateral x-ray irradiation of 17 kV (7 to 8 KeV) and 50 kV (12 KeV) was studied on 260 rats. The distribution of absorbed dosages in the animal body and in different radiosensitive organs was investigated. The contribution of the hemopoietic syndrome, the gastrointestinal syndrome, and skin injuries to the total biological effect is discussed on the basis of a comparative examination of clinical manifestations of the radiation damage as related to the distribution of the absorbed dosages in tissues and organs. (auth)

8022 INCREASED NUCLEAR DIAMETER OF GASTRIC PARIETAL CELLS AFTER X IRRADIATION IN THE GUINEA PIG. Capoferro, R. Acta Pathol. Microbiol. Scand., Sect. A, Suppl.; 81: 591-592(1973).

In the guinea pigs, diameters of parietal cell nuclei were measured at intervals of from 4 to 372 days after irradiation of the stomach. Five strips were cut from each stomach: one from the lesser curvature, two from the anterior and two from the posterior wall. Twelve parietal cell nuclei were measured in each section. The nuclei size increased significantly after irradiation, and the highest values were found after 4 days. Later on a gradual decrease seemed to take place. The marked increase of the parietal cell nuclear diameter might be an inherited sign of degeneration of the undifferentiated cells in the neck area of gastric glands, caused by x rays. The mechanism by which x rays increase nuclear diameter is not clear. X irradiation might represent a useful technique for investigation of the various factors that influence the nuclear size. (DE)

8023 HEMATOPOIETIC COLONY FORMATION IN A MACROPHAGE LAYER PROVIDED BY INTRAPERITONEAL INSERTION OF CELLULOSE ACETATE MEMBRANE. Seki, M. (National Inst. of Radiological Sciences, Chiba, Japan). Transplantation; 16: No. 6, 544-549(Dec 1973).

When a piece of cellulose acetate membrane (CA membrane) is surgically inserted into the peritoneal cavity of a C3H/He mouse, a macrophage layer forms on the membrane. This was examined for its hematopoiesis-sustaining potentiality. After whole-body irradiation, membrane-bearing mice were injected i.p. with aliquots of isologous or homologous bone marrow cells. Myeloid colonies derived from donor bone marrow cells formed in the macrophage layer within several days of inoculation. The majority of the colonies was granuloid in nature; however, erythroid colonies were observed distinctly in some cases. Remarkable heterogeneity was noticed in the granuloid colonies. Colony-forming units on the CA membrane 2 days after bone marrow inoculation were shown. In conclusion, an artificial layer of peritoneal macrophages can in part perform the function of reticuloendothelial cells to sustain hemopoiesis. (auth)

8024 SPECIFIC INACTIVATION OF CYTOTOXIC LYMPHOCYTES AFTER ADSORPTION OF ^{51}Cr-LABELED FIBROBLAST MONOLAYERS. Ritter, J.; Lohmann-Matthes, M. L.; Fischer, H. (Max-Planck Institut fuer Immunbiologie, Freiburg i. B.). Transplantation; 16: No. 6, 579-582(Dec 1973).

Immune C57BL anti-DBA/2 spleen cells are incubated on DBA/2 fibroblast monolayers that were labeled to a high activity with ^{51}Cr. After 90 min of incubation their cytotoxic potential is only slightly decreased as compared to immune lymphocytes adsorbed on unlabeled DBA/2 or nonrelevant C57BL monolayers. However, 18 hr later their cytotoxic potential is almost completely abolished, whereas in control situations the sensitized lymphocytes retain their full cytotoxic capacity. The reaction seems to be specific. The recovered cells can be sensitized against third party cells in a graft-versus-host reaction. Furthermore, the recovered cells are capable of restoring lethally irradiated C57BL mice as measured by the plaque-forming cell response to sheep red blood cells. The specific elimination of cytotoxic lymphocytes in this system is mainly performed by the K_α radiation of ^{51}Cr, which leads to interphase death of the radiosensitive cytotoxic lymphocytes. (auth)

8025 FOREIGN ANTIGENICITY IN TISSUES OF MICE INFECTED WITH A LYMPHOMAGENIC VIRUS. I. Antigenicity of Spleen Cells. Salaman, M. H.; Turk, J. L.; Wedderburn, N. (Royal Coll. of Surgeons of England, London). Transplantation; 16: No. 6, 583-590(Dec 1973).

When normal BALB/c mice are infected with the lymphomagenic virus, urethane lymphoma virus (ULV), their spleens acquire a new antigenicity, demonstrable by weight increase of popliteal lymph nodes (PLNs) of syngeneic normal recipients 7 days or more after the infected spleen cells have been injected into their hind footpads. This antigenicity becomes detectable during the 1st week after infection of the donors. At about the same time infected mice lose their ability to react by PLN enlargement to footpad injection of spleen cells from donors infected with the virus 2 weeks or more previously. The antigenicity of infected spleen cell suspensions is reduced but not abolished by x-irradiation in vitro. Virus preparations freed of cell debris are not antigenic. Nonreactivity of infected mice to footpad inoculation of infected spleen cells is not caused by a nonspecific immune depression by the virus: infected mice show no significant depression of reactivity, in the PLN test, to allogeneic spleen cells differing at a non-H-2 locus. Preliminary tests show that other murine lymphomagenic viruses produce changes of antigenicity in the spleen analogous to those described for ULV. (auth)

8026 ROLE OF DONOR PASSENGER LEUKOCYTES IN RAT SKIN ALLOGRAFT REJECTION. Kyger, E. R. III.; Salyer, K. E.

(Univ. of Pennsylvania, Philadelphia). Transplantation; 16: No. 6, 537-543(Dec 1973).

There has been much speculation on the role of donor passenger leukocytes carried with allografts in the ultimate rejection of these allografts. Results of skin graft donor pretreatment with irradiation, cyclophosphamide, and antilymphocyte serum in various doses and time intervals are presented. Donor pretreatment with irradiation is shown to be superior in prolonging mean graft survival time, and lower doses followed by a longer time interval are shown to be superior to higher doses and a shorter time interval. Much of the difficulty in evaluating previous work on the role of donor passenger leukocytes is attributable to the fact that the exact extent of the donors' hematopoietic chimerism has not been determined. Results are presented using skin grafts from donors that within the limits of bone marrow karyotype analysis and fluorescent antibody study of lymph node suspensions are 100% hematopoietic chimeras. Grafts from these donors will not sensitize recipients if removed after 48 hr, but will if left in place for 7 days. Untreated control grafts and irradiated isogeneic repopulated grafts sensitize recipients if left in place 48 hr. From these data, the role of donor passenger leukocytes in rat skin allograft rejection would appear to be limited in extent, probably to the period before vascular and lymphatic connections are established between the graft and its host. (auth)

8027 EFFECT OF HIGH DOSES OF X RAYS ON THE NEUROSECRETION OF CAT'S HYPOTHALAMUS. Kopaczyuk, F.; Kowalski, E.; Pawlaczyk, J. (Academy of Medicine, Poznan, Poland). Med. Pracy; 23: 139-148(1972). (In Polish).

The effect of high doses of x radiation upon the hypothalamo-hypophyseal system was studied in 15 adult cats, both male and female. It was observed that ionizing radiations accelerate the passing of neurosecreta from cells to axons and from posterior lobe of the pituitary body to the vascular system. (auth)

8028 EFFECT OF LUNG IRRADIATION ON THE INCIDENCE OF PULMONARY METASTASES IN MICE. Brown, J. M. (Stanford Univ., CA). Brit. J. Radiol.; 46: No. 548, 613-618(Aug 1973).

Intravenous injection of KHT sarcoma cells into syngeneic C3H mice produces tumor nodules or colonies the number of which is directly proportional to the number of viable cells injected. Localized x irradiation of the lungs prior to cell injection over a range 0 to 2000 rads was found to increase the number of lung colonies arising from the injection of a given number of tumor cells. This increase was dose-dependent, transitory in nature, and resulted from a reduced clearance of viable tumor cells from the capillaries of the lungs. (auth)

8029 INFLUENCE OF ACUTE AND FRACTIONAL X IRRADIATION ON INDUCTION OF INTERFERON IN VIVO. Talas, M.; Szolgay, E.; Varteresz, V.; Koczkas, G. (National Research Inst. for Radiobiology and Radiohygiene, Budapest). Arch. Gesam. Virusforsch.; 38: 143-148(1972).

Acute x irradiation with 350 R increased the synthesis of interferons induced by poly-I:C and endotoxin in individual sera of BALB/c mice. Fractional irradiation with 4.7 or 9.4 R daily up to total dose levels of 728, 977, and 1828 R in three different experiments had no influence on serum interferon levels induced by Semliki Forest Virus (SFV), poly-I:C, or endotoxin. The Newcastle Disease Virus (NDV) induced interferon synthesis decreased in comparison to the non-irradiated control at a total dose of 400 R and attained the control level on further elevation of the total dose. The anti-NDV antibody production fell to one quarter of the control value after exposure to a total dose of 1828 R. (auth)

8030 CHANGES IN THE ENZYMATIC EQUIPMENT OF THE ABSORPTION CELLS OF THE SMALL INTESTINE IN GUINEA PIGS AFTER WHOLE-BODY IRRADIATION. Otoupal, P.; Lojda, Z.; Hrusovsky, J. (Military Veterinary Research Inst., Prague). Vet. Med. (Prague); 18: No. 8, 515-521(Aug 1973). (In Czech).

The enterocytes of different parts of the small intestine of guinea pigs, three and a half and twelve months old and irradiated with the dose of 260 R (dose lower than LD 50/30) of ^{60}Co all over their bodies, were examined histochemically for alkaline and acid phosphatase, leucyl-β-naphthylamidase, sucrase, trehalase, non-specific esterase, α-glycerolphosphatdehydrogenase, and succinate-dehydrogenase. The small intestine was examined 6 and 12 hrs, 1, 3, 5, and 8 days after irradiation. It was already 12 hrs after irradiation that an activity drop was observed in non-specific esterase, acid phosphatase, and partially, in succinatedehydrogenase and α-glycerolphosphat-dehydrogenase. On the other hand, disacharidases and leucyl-β-naphthylamidase showed a temporary activity increase after 12 hrs. By the third to fifth day the activities returned to the levels of the control group. Within the enterocytes in different parts of the small intestine reacted in a similar way. Where the proximodistal gradient was present in the enzymatic equipment, it remained the same after irradiation. In the younger animals, the changes occurred more quickly than in older guinea pigs. The results show that the digestive and metabolic capacity of enterocytes is already changed in the course of the first three days after irradiation with doses lower than LD 50/30. (auth)

8031 ULTRASTRUCTURAL CHANGES IN THE PLASMATIC MEMBRANE OF CELLS UNDER PATHOLOGICAL CONDITIONS. Lebkova, N. P. Arkh. Patol.; 35: No. 9, 25-32(1973). (In Russian).

Ultrastructural changes in the plasmatic membrane of parenchymatous and endothelial cells of the myocardium, liver, and thyroid gland under various pathological conditions (diabetes and its combination with additional affections, irradiation, nephrotoxic nephritis of Mazuguy as well as in the cells of paragangliomas and insulomas) were studied. The changes were in the form of ruptures, fragmentation, loosenings of the plasmolemma and its exfoliations from the cell's surface. They can be seen in the cells with a slightly changed structure of other organelles, it justifies to the primary character of changes in the plasmolemma. A possibility of penetration of organelles from cells with a damaged membrane into interstices and capillaries and the entrance by this way of cellular antigens and enzymes into the blood flow and lymphs was put forward. Restoration of the plasmolemma in the cells of the myocardium in Alloxan diabetes is shown. (auth)

8032 INFLUENCE OF LOW-ENERGY X IRRADIATION ON NEUROSECRETORY ACTIVITY IN THE HYPOTHALAMUS OF MICE. Lach, H.; Srebro, Z.; Krawczyk, S. (Medical Academy, Krakow). Folia Biol. (Krakow); 21: No. 3, 313-318(1973).

Whole-body irradiation with a single dose of 2100 R of low-energy x rays (20.5 to 50 kV) of adult mice results in a considerable increase in the secretory activity of neurosecretory ganglion cells of the supraoptic and paraventricular nucleus of the hypothalamus. This is evidenced by a statistically highly significant increase in nuclear volume of the neurosecretory cells, observed on day 7 and day 14 post irradiation. The changes at day 14 are more pronounced than on day 7 post irradiation. (auth)

8033 DEVELOPMENT OF LATE PATHOMORPHOLOGICAL CHANGES IN THE TESTES AFTER IRRADIATION OF NEWBORN MICE WITH SUBLETHAL DOSES OF X RAYS. Chomiczewski, K. (Dept. of Pathological Anatomy, Lodz, Poland). Folia Biol. (Krakow); 21: No. 3, 279-287(1973).

Newborn mice of the inbred A strain were irradiated with 300 R of x rays on the whole body, and post-radiation changes in the testes after 4, 18, 35, 45, 100, 150, and 250 days were studied. DNA content in the nuclei of spermatogonia of the irradiated mice was already diminished on the 4th day of life. The consequence of these changes was serious irreversible inhibition and damage of spermatogenesis and spermiogenesis throughout the period of observation. The results indicate marked radiosensitivity of the testes of newborn mice. (auth)

8034 DEVELOPMENT OF LATE PATHOMORPHOLOGICAL CHANGES IN THE OVARIES AFTER IRRADIATION OF NEWBORN MICE WITH SUBLETHAL DOSES OF X RAYS. Chomiczewski, K. (Dept. of Pathological Anatomy, Lodz, Poland). Folia Biol. (Krakow); 21: No. 3, 289-296(1973).

A study on the pathomorphological changes in the ovaries of mice irradiated with 300 R of x radiation revealed that ionizing radiation destroyed about 70% of the egg cells and primitive follicles in the ovaries of newborn mice. The surviving follicles matured incompletely, as shown by degenerative forms. Between days 100 and 150, in irradiated females the surviving primitive follicles terminated their maturation cycle. At the same time, the ovaries of control mice showed intensive activity. Starting on day 150, proliferation of granulosa and thecal cells was observed in the stroma. Injury of the ovaries was correlated with changes in the pituitaries and adrenals in the same animals. (auth)

8035 LYSOSOMAL ENZYMES IN DRIP AND MUSCLE OF HARPODON NEHEREUS. Warrier, S. B. K.; Ninjoor, V.; Sawant, P. L.; Kumta, U. S. (Bhabha Atomic Research Centre, Trombay, India). Indian J. Biochem. Biophys.; 9: No. 2, 207-209(1972).

Freezing and thawing in presence of non-ionic detergents, before and after irradiation, failed to demonstrate latency associated with lysosomal hydrolases of the muscle of Bombay duck (Harpodon nehereus). However, there was increased activity of lysosomal enzymes in the drip obtained from the muscle of this fish following irradiation or freezing. Treatment of muscle with sodium tripolyphosphate reduced the levels of lysosomal enzymes released into the drip. Preliminary evidence is also presented for the presence of inhibitors of cathepsin and β-glucuronidase in the fish. (auth)

8036 TUBULE FUNCTION OF THE COMPENSATORY HYPERTROPHIED RAT KIDNEY FOLLOWING X-IRRADIATION. Bargon, G. (Institut fuer Klinische Radiologie, Hanover). Zen-

tralbl. Allgem. Pathol. Pathol. Anat.; 116: No. 3–4, 396–400 (1972). (In German).

The right kidney of rats was removed surgically. Two days after nephrectomy, the left kidney was irradiated with 3000 rad. Histological examinations as well as tubule function tests were performed on days 21, 42, and 63 postirradiation. On day 21, a compensatory increase of tubule function was still apparent in the irradiated kidney. Later, the compensatory hypertrophy led to an enhanced regeneration of epithelium which produced pathological forms of cells. These pathological cells did not function normally. (HBG)

8037 EFFECTS OF RADIATION ON GROWTH OF CAUDAL VERTEBRAE OF MOUSE FETUS. Yoshizawa, Y.; Ueda, K. (Tokyo Univ.). J. Radiat. Res.; 14: No. 1, 1–8(Mar 1973).

A total of 333 pregnant mice (ddY strain) and their 2759 fetuses were used. When radio-induced delay of ossification was used as an indicator of radiation effects on fetal growth, the gestation ages 8 and 16 days were found to be two radiosensitive stages. The degree of the delay of ossification was enhanced with increasing radiation dose. However, the radioinduced delay, estimated from the number of ossified caudal vertebrae on day, was only slightly dependent on the dose rate (1 R/min to 100 R/min). The number of ossified caudal vertebrae in response to fetal irradiation was paralleled to the body weight of the fetus. (auth)

8038 EFFECTS OF IRRADIATION ON THE VASCULARITY OF THE RAT LUNG. Kawamura, F.; Fujiwara, K; Bando, K.; Oe, J.; Takegawa, Y. (Tokushima Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 15, 412–417(May 1973). (In Japanese).

The effects of irradiation on the intravascular volume of rat lung were investigated with respect to change of intravascular volume with time after irradiation, the effect of the dose of irradiation, the influence of the quality of radiation, and the effect of fractionation of the dose. After a single irradiation with 1000 rad, applied locally to the lung, the intravascular volume increased significantly in 1 to 3 days and decreased again 7 to 14 days after irradiation. The effects of doses of 200 to 1000 rad were examined. Increase of the intravascular volume was observed following irradiation with doses of 400 rad or more and the increase was proportional to the dose applied. To examine the influence of the quality of radiation, animals were irradiated with 1000 rad of 200 KV x rays, ^{60}Co γ rays, 6 MV x rays, and 12 MeV electrons. The increases in intravascular volume following irradiation with ^{60}Co γ rays, 6 MV x rays, and 12 MeV electrons were almost the same, and were less than those in animals irradiated with 200 KV x rays. To study the effect of dose fractionation, a total dose of 1200 rad was applied in 4, 6, and 12 fractions over a period of 14 days and the intravascular volume was measured 1 and 2 weeks after the first irradiation. Results suggested that, when the overall time and total dose were constant, change in the intravascular volume decreased with increase in the number of fractionations. (auth)

8039 RELATIVE BIOLOGICAL EFFECTIVENESS OF FAST NEUTRONS, OBSERVED IN THE SKIN REACTION OF MICE, AFTER SINGLE OR FRACTIONATED IRRADIATION. Aizawa, H. (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 33: No. 7, 602–616(Jul 1973). (In Japanese).

This experiment was carried out to estimate the relative biological effectiveness (RBE) of x rays and fast neutrons in reactions of irradiated skin. Experimental animals used were C^{3}H/He mice, aged 8 weeks. Mean skin reaction scores for early reaction were calculated from the scores obtained from the 8th to 30th day after irradiation, and those for late reaction were from the 2nd to 10th month. The mean energy of fast neutrons was 2 MeV, and x rays was 200 kV with HVL of 1.12 mmCu. The time course of early skin reaction following fast neutrons was essentially the same as that of x rays. However, the durations of late skin reactions produced by fast neutrons were slightly longer than those produced by x rays. The RBE of early skin reactions was 1.9, 2.4, and 2.4 for the mean skin reaction scores of 1.0, 1.5, and 2.0, respectively. The RBE for late skin reactions was higher than that of early reactions and the values were 3.7, 3.8, and 4.0 for the mean skin reaction scores of 0.5, 1.0, and 1.5, respectively. By split dose experiments, D_2-D_1 values, which described the recovery of the skin injuries after irradiation, were estimated in both of early and late skin reactions. For early skin reactions, D_2-D_1 values were 500 to 600 rads at 24 hr intervals and 980 rads at 48 hr intervals for x-rays, and 75 rads at 24 hrs. and 125 rads at 48 hrs for fast neutrons. In late skin reactions, the D_2-D_1 values at 24 hrs were 600 rads for x rays and 100 rads for fast neutrons. Although the recovery rate of irradiated cells was less in the case of fast neutrons than x rays, the extent of late skin reaction for the neutron cases decreased when the interval between split dose was extended up to 5 days. Fractionation schemes in the fast neutron therapy should be carefully planned to minimize late skin damage after irradiation. (auth)

8040 SENSITIVITY OF THE MOUSE OOCYTES TO THE INDUCTION OF TRANSLOCATIONS BY IONIZING RADIATIONS. Gilliavod, N.; Leonard, A. (Nuclear Energy Study Center, Mol, Belg.). Can. J. Genet. Cytol.; 15: No. 2, 363–366(Jun 1973).

Female mice from the C57Bl strain received 0, 50, or 200 R doses of whole-body x irradiation and were mated to control males from the same strain. Using an air-drying technique, the testes of the F_1 males were analyzed for the presence of chromosome rearrangements, but no translocation configurations were observed in the dividing spermatocytes of the 100 control males and of the 185 F_1 sons from irradiated females. Since meiotic preparations made one day after exposure of the females to x irradiation showed the presence of chromosome rearrangements in some first meiotic metaphases, it could be inferred that the absence of translocated offspring after maternal x ray exposure probably resulted from germinal selection. (auth)

8041 VASCULAR ALTERATION IN THE IRRADIATED SUBMANDIBULAR GLAND OF RABBIT. Microangiographic Study. Kashiwagi, Y. (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho; 93: 1–18(May 1973). (In Japanese). (In Japanese).

The vascular changes of the salivary gland following irradiation were evaluated using microangiography. One side of the submandibular glands of male rabbits was irradiated with a cobalt-60 unit. Doses of 1000, 3000, and 5000 R were given in daily fractions of 1000 R. Morphological changes of fine vasculature of the irradiated submandibular gland were observed microangiographically from six hours to three months after irradiation and, at the same time, histological changes were investigated. Interstitial edema and perivascular inflammation with a dilatation of arterioles and capillaries diffusely distributed in the entire gland were observed shortly after irradiation with 1000 R. Two weeks later, these changes had subsided. The patchy distribution of hypovascular areas was found after 3000 R irradiation. A dilatation of capillaries was not so marked as seen in the glands irradiated with 1000 R. A dilatation of capillaries was concomitant with interstitial (interlobar and interlobular) fibrosis after one month following irradiation of 3000 and 5000 R. The endothelium of the fine vasculature showed radiosensitivity and later chronic changes in the acini seem to be secondary to the progressive changes in the connective tissue and fine vasculature. (auth)

8042 NON-REACTIVITY OF INCOMPATIBLE LYMPHOID CELLS FROM F_1 MODIFIED RADIATION CHIMERAS TO HOST TUMOR CELLS IN VITRO. Grant, C. K. (Chester Beatty Research Inst., Sutton, Eng.); Ilbery, P. L. T. Biomedicine; 19: No. 2, 56–60(10 Feb 1973).

Irradiated DBA/2 mice were injected with a mixture of C_{57}Bl × DBA/2)F_1 bone marrow. Three months later their lymphoid cells were shown to be predominantly of C_{57}Bl origin by specific antisera testing. Spleen cell suspensions and peritoneal exudate monolayers were prepared and tested for reactivity to host-type lymphoma cells in vitro. No cytotoxic activity was detected by the use of either growth inhibition or ^{51}Cr release assay methods. However, cytotoxic peritoneal exudate monolayers (but not cytotoxic spleen cells) were obtained from chimeras previously immunized with irradiated tumor cells. These experiments indicate that lymphoid cells in chimeric mice are not reactive to the transplantation antigens of the host; nevertheless, such mice may react in a manner similar to normal mice after sensitization by tumor specific antigen. (FR)

8043 EFFECTS OF ^{60}Co GAMMA RADIATION ON THE DISTRIBUTION, CATABOLISM, AND INCORPORATION OF ^{125}I-5-IODO-2'-DEOXYURIDINE INTO INTESTINAL AND SPLENIC DEOXYRIBONUCLEIC ACID IN MICE. Johanson, K. J. (Uppsala Univ.). Acta Radiol., Ther., Phys., Biol.; 11: No. 6, 556–565 (Dec 1972).

The effect of 200 rad of ^{60}Co gamma radiation on the kinetics of the distribution and catabolism of ^{125}IUdR was investigated in mice. No significant changes were observed. Fluorouracil injected before ^{125}IUdR increased its incorporation into DNA. This increase was more marked at 2 hrs after irradiation, indicating that changes in the thymidine pool due to flooding of thymidine from dead cells are of minor importance. (auth)

Invertebrates

8044 (STI/PUB-340) COMPUTER MODELS AND APPLICATION OF THE STERILE-MALE TECHNIQUE. Proceedings Series.

Proceedings of a Conference Held in Vienna, December 13–17, 1971. (International Atomic Energy Agency, Vienna (Austria)). 1973. 198p. (CONF-711230-). IAEA $8.00.

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971).

Separate abstracts were prepared for the 17 papers presented at the conference. The publication also includes a glossary of computer terms and a discussion of recommendations with regard to the sterile male technique and computer simulation. (HLW)

For abstracts of individual papers see: 8045–8060 and 9723.

8045 VIEW OF COMPUTER SIMULATION IN STERILE MALE EXPERIMENTS. Cuellar, C. B. (London Univ.). pp 5-15 of Computer Models and Application of the Sterile Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

A brief historical introduction is followed by a discussion of two models of sterile male releases into an insect population. The importance of biological parameters is emphasized by the apparently diverging results. In the specific case of tropical anopheline vectors of malaria some theoretical possibilities are mentioned and a hypothesis put forward that in some instances, for purely biological or logistic reasons, simultaneous releases of sterile males and females in the same area might be more efficient than sterile males alone, or sterile males and females in separate areas. (auth)

8046 PRINCIPLES OF THE STERILE MALE TECHNIQUE WITH EMPHASIS ON ECOLOGY. Weidhaas, D. E. (Dept. of Agriculture, Gainesville, FL). pp 17-22 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

The principles and models for the sterile male release technique are reviewed in detail with examples to illustrate the basic concepts involved, i.e., that ratios of sterile to fertile insects that cause levels of sterility high enough to balance or overcome the reproductive success of the existing population can limit the increase in density of such populations or result in extremely high levels of control or actual elimination. Requirements for the technique are reviewed. Simplified equations for the technique are presented. Particular emphasis is given to the usefulness of the models for the sterile male release technique as a concept for total population suppression by other methods of control and as a biological tool for studying population dynamics and ecology. Specific examples are presented. Sterility itself is an extremely useful means of tagging insects. Since valid results depend upon sterile insects dispersing and mating, this type of tagging system could be extremely useful in determining absolute population density and reproductive success under natural field environments. Data on population dynamics and ecology obtained from sterile insect releases could be used to confirm similar information obtained by other ecological methods. Problems associated with the use of insect sterility as a biological tag are reviewed. Finally, the relative efficiency of the sterile male release technique at high and low density levels is reviewed in the light of the need for integrating this technique with other methods of control. (auth)

8047 COMPUTER MODELLING OF THE DYNAMICS OF INSECT POPULATION. Frissel, M. J.; Wijnands-Staeb, K. J. A. (EURATOM, Wageningen, Netherlands). pp 23-29 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

To develop a model of an ecosystem, such as the dynamics of an insect population after the release of sterile and/or translocation insects, several aspects are of main importance: Careful selection of processes and parameters which have to be included in the model, so that maximum insight is guaranteed. Therefore a team of entomologists and model builders should evaluate the available knowledge and the possibility of combining the information in a simulation model in close cooperation. The model structure should be flexible and should easily allow modifications. Therefore it has to be divided into submodels, each one describing a separate part of the overall model. Selection of the language which will be used to reach the proposed aims. At present a combination of CSMP and FORTRAN seems to be the best choice. (auth)

8048 COMPUTER SIMULATION OF POPULATION REDUCTION BY RELEASE OF STERILE INSECTS. II. The Effects of Dynamic Survival and Multiple Mating. Berryman, A. A.; Bogyo, T. P.; Dickmann, L. C. (Washington State Univ., Pullman). pp 31-43 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

A previous model described the effects of sterile male releases on wild populations as a function of several discrete parameters. In this model some of these parameters were assumed constant although it was acknowledged that they were in nature dynamic functions of population density. Simulations using a model extended by making the probability of survival as well as the probability of mating dependent on population density is described. The incorporation of these dynamic population components into the model has important effects on the outcome of sterile male release strategies. (auth)

8049 APPROACH TO MODELLING SPATIALLY HETEROGENEOUS POPULATIONS AND THE SIMULATION OF POPULATIONS SUBJECT TO STERILE INSECT RELEASE PROGRAMS. Wehrhahn, C. F. (Univ. of British Columbia, Vancouver). pp 45-64 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

Heterogeneity in density may be present at the start of an insect control program and is subsequently generated by sampling of successful parents and by variation in family size. This heterogeneity is markedly accentuated with time by a sterile insect release program. Of particular interest is the fact that models that do not take into account spatial heterogeneity in density provide very erroneous predictions of the total number of fertile insects present at any time. They also suggest optimal control strategies that are in error. Because variation in density is eroded by diffusion of insects, those species that have moderately high powers of dispersal are easiest to eradicate. (auth)

8050 POPULATION SUPPRESSION WITH DOMINANT AND CONDITIONAL LETHAL MUTATIONS: SOME IMPORTANT CONSIDERATIONS AND APPROACHES. Klassen, W.; Creech, J. F. (Dept. of Agriculture, Washington, DC). pp 65-79 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

The rate of increase of the population to be suppressed determines the effectiveness of combinations of levels of male sterility and release ratios. When the rate of increase is fivefold, 90% male sterility is effective at fairly low release ratios. By contrast, when the rate of increase is tenfold or greater, the level of sterility must be near 98% to induce a steep downward trend in the target population. The implication of these conclusions for the pilot boll weevil eradication experiment is discussed. Computations are presented to demonstrate the usefulness of the inability to diapause as a dominant conditional lethal trait. Such traits when combined with dominant lethals or with insecticide applications represent a potential powerful and practical tool for suppression of populations. The possible application of these methods is discussed for the pink bollworm in southwestern United States and adjacent areas of Mexico. (auth)

8051 SOME APPLICATIONS OF COMPUTER MODELLING IN POPULATION SUPPRESSION BY STERILE MALES. Monro, J. (Seibersdorf Lab., Vienna). pp 81-94 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

The size of a population is dependent only on the initial population size and age distribution and the age-specific survival and fecundity over any later time interval. Thus the basis of modelling a population is simple though the models themselves may be complex. Computer simulation has value in suggesting general strategies of control and in predicting the outcome of specific treatments of specific pest populations. Several examples are given. Application of this technique is to some extent blocked by a shortage of relevant data. Simulation will make its full contribution to the sterile-male technique when ecological, programming, and ad-

ministrative skills are brought together from the beginning to plan, operate, and assess a complete campaign. (auth)

8052 COMPUTER SIMULATION FOR GENETIC CONTROL OF THE ONION FLY HYLEMYA ANTIQUA (MEIGEN). Wijnands-Staeb, K. J. A.; Frissel, M. J. (EURATOM, Wageningen, Netherlands). pp 95-111 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

A computer model for simulation of onion fly populations in the field is described. The model works with a density-related growth rate and the possibility to randomize the values of growth rate by a Gauss distribution. Equations for the reproductive process are given, which allow calculations with steriles as well as with aberrant genotypes. Computer simulations for releases of steriles, translocations and incompatible strains are discussed. The release of translocations can be useful to prevent recovery of a population at the end of a sterile-release program. Suppression of an onion fly population by release of one single translocation seems impossible. Statistical fluctuation of the growth rate may simulate environmental influences, like weather conditions. The influence of statistical fluctuations on the application of sterilized flies is discussed. Schedule and data of a sterile-release field experiment with the onion fly are mentioned, with emphasis on the consequences for computer simulations. (auth)

8053 DYNAMIC ASPECTS OF THE PALA STERILE HYBRID FIELD EXPERIMENT. Cuellar, C. B. (London Univ.). pp 113-118 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

In Pala, near Bobo Dioulasso, Upper Volta, West Africa, about 240,000 sterile male hybrids of the cross Anopheles gambiae species B/Anopheles melas were released over nine weeks into a declining population of Anopheles gambiae species A. On prima facie evidence it was concluded that the sterile males were not mating on any significant scale with the target females. However, a reassessment of the available data has suggested the strong possibility that many of the captured females could have been survivors from the massive emergencies which took place before the beginning of the trial and from the period where the releases were insufficient, and also that the emerging target females suffered extra mortality in the field during the period of releases. For the scientist, field experiments are not success-failure gambles, but an opportunity for practical feedback and the generation of ideas for further field and laboratory work. (auth)

8054 DEVELOPMENT OF A POPULATION MODEL OF COTTON RED BOLLWORM AS A BASIS FOR TESTING PEST CONTROL STRATEGIES. Murdie, G. (Imperial Coll. of Science and Tech., London). pp 119-128 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

A population model was developed as a basis for computer simulation of control methods against the red bollworm, Diparopsis castanea Hmps., a pest of cotton in Central and Southeast Africa. The ecological model described simulates field populations of the bollworm and is based on published information of its biology and ecology. The model is being developed for use as an experimental tool to compare control strategies in preparation for field trials. A comparison is made between computer experimental results obtained using the ecological model and those from a simple Berryman model. The importance of integrating field and computer experiments for development of computer and field control programs is discussed. (auth)

8055 POSSIBILITIES OF USING THE STERILE MALE TECHNIQUE FOR APHID CONTROL: A THEORETICAL DISCUSSION. Steffan, A. W. (Institut fuer Zoologie der Biologischen Bundesanstalt fuer Land und Forstwirtschaft, Berlin); Kloft, W. J. pp 129-136 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

Aphids are serious plant pests that induce both direct and indirect damage to crops, particularly by transmitting virus diseases. Little attention has been paid to the possibility of utilizing genetic methods, primarily the sterile male technique, for the control of these pests. Reasons for this include the tremendous mass infestations observed during the growing season and parthenogenetic reproduction. However, in moderate climates a cyclic change from parthenogenetic to bisexual reproduction occurs. A theoretical discussion on the possibilities of utilizing the sterile male technique for aphid control is presented. (auth)

8056 FIELD STUDIES ON INSECT STERILIZATION WITH MOSQUITOES, HOUSE FLIES, AND STABLE FLIES. Weidhaas, D. E. (Dept. of Agriculture, Gainesville, FL). pp 137-139 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

Field tests on the release of radiation or chemosterilized mosquitoes, stable flies, and house flies are reviewed with particular emphasis on the potential of the method, reductions in density and reproductive success of the populations under stress of total population control. The results with house flies include experiments with sterility utilizing chemosterilant baits. Insects of reputed high biotic potential were shown to have low rates of reproductive success under given environmental conditions. (auth)

8057 RESUME OF REQUIREMENTS FOR A STERILE INSECT RELEASE PROGRAM EXCLUSIVE OF BASIC LABORATORY AND FIELD CAGE STUDIES. Butt, B. A. (Dept. of Agriculture, Yakima, WA). pp 145-148 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

A sterile insect release program requires a dependable production and release of high-quality sterile insects into the field. The ecology, numbers and distributions of the target insect should be known before mass field releases begin. (auth)

8058 SOME BIOLOGICAL OBSERVATIONS RELATED TO CODLING MOTH CONTROL BY THE STERILITY PRINCIPLE. Proverbs, M. D.; Logan, D. M.; Carty, B. E. (Canada Dept. of Agriculture, Summerland, B. C.). pp 149-163 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

Although the female codling moth Laspeyresia pomonella (L.) is polygamous, most of the eggs are laid before the second mating. Consequently, if transfer of irradiated sperm elicits normal oviposition, it will not be a serious handicap to control if the sperm is noncompetitive. Unlike fully sterile sperm (40 krad dose), partially sterile sperm (25 krad) induced normal oviposition, satisfied the mating instinct of the wild female, and evidently was only slightly less competitive than untreated sperm. Release of mixed sexes for suppression of reproduction is often stated to be as efficient as or superior to release of sterile males only. This may not be so for the codling moth because, when the wild moth population was low, the rate of sterile male dispersal (and consequent chance of mating with wild females) was more rapid in the absence of sterile females. Estimates of adult codling moth populations, by release-recapture procedures, are influenced by the method used for capturing the insects. With female-baited traps the ratio of laboratory to wild males captured was smaller with untreated wild females than with laboratory reared females treated with 40 krad of gamma radiation. With black-light traps the ratio of males to females captured during the first night of trapping was approximately 7:1 for sterile laboratory-reared moths but only 2:1 for naturally occurring wild moths. Rate of population increase per generation is most variable and even more difficult to predict. Increase per generation in field cages averaged 6-fold, but there was considerable variation (2- to 28-fold). More detailed information is needed on the behavior of wild and irradiated laboratory-reared codling moths before an accurate mathematical model can be constructed to simulate the sterile moth release method for control of this insect. (auth)

8059 PRELIMINARY STUDIES OF MEDITERRANEAN FRUIT FLY CERATITIS CAPITATA WIED. POPULATIONS IN CYPRUS. Serghiou, C.; Zyngas, J.; Krambias, A. (Ministry of Agriculture and Natural Resources, Nicosia, Cyprus). pp 165-176 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

Surveys conducted in Cyprus in the years 1969-1971 showed

that Mediterranean fruit fly Ceratitis capitata Wied. populations were very low in winter and spring, increased in summer and reached peak populations in the fall. In a test for the evaluation of different types of traps baited with trimedlure, best results were obtained with the McPhail glass trap, the metal sticky trap and the Steiner trap. Data collected in 1971 in a preliminary field trial for the control of the Mediterranean fruit fly by the use of the sterile insect release method and related data of laboratory tests and of tests under cages in the field are discussed. (auth)

8060 USE OF SIMULATION IN THE CHOICE OF AN OPTIMUM RADIATION DOSE FOR CONTROL OF GLOSSINA MORSITANS. Curtis, C. F. (Tsetse Research Lab., Langford, Eng.). pp 177-181 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

A computer simulation method was devised to determine the dose of irradiation which, when given to male tsetse flies, would be optimum for both sterility and effectiveness in suppressing a wild population. A deterministic model was used; the assumptions included non-overlapping generations, an initial insecticide treatment and releases of males only. Among treatments of 12, 17, and 30 krad, 17 krad was calculated to cause the most rapid population decline and to be most efficient as regards the numbers to be released for achieving a given population reduction. (auth)

8061 GROWTH AND CLONING OF TETRAHYMENA PYRIFORMIS ON SOLID MEDIUM. Gardonio, E.; Crerar, M.; Pearlman, R. E. (York Univ., Downsview, Ont.). J. Bacteriol.; 116: No. 3, 1170-1176(Dec 1973).

A method of obtaining clones of Tetrahymena pyriformis on solid medium has been developed. The medium consists of a basal layer of 1.5% agar topped with 2 ml of 0.3% agar in sterile, plastic petri plates (100 by 15 mm). Both agar layers contain either 2% proteose peptone and 0.1% liver extract (complex medium) or defined medium supplemented with proteose peptone. After drying, 0.5 ml of liquid culture is spread evenly over the top agar, and the plates are then sprinkled lightly and evenly with autoclaved dry Sephadex G-25 (fine). Cell colonies can be observed after 5 days of incubation either by viewing with a microscope or without the aid of a microscope after staining. Plating efficiency is high on either complex or defined medium with a number of strains of Tetrahymena, both micronucleate and amicronucleate. Colonies can be picked and transferred to liquid culture for further growth. The existence of clones was demonstrated by plating a mixture of two different drug-resistant mutants. The method should prove useful in selective procedures for the isolation of mutants and for determining survival after treatments such as ultraviolet irradiation. (auth)

8062 EFFECT OF X RAYS ON THE VIRULENCE OF THEILERIA ANNULATA. Abramov, I. V.; Zablotskii, V. T. (Inst. for Experimental Veterinary Medicine, Moscow). Veterinariya; 10: 91-93(Oct 1972). (In Russian).

X irradiation of 3000 to 5000 R did not attenuate the virulence of Th. annulata in starving adult ticks, Hyalomma anatolicum, or suspensions from the organs of animals infected with the organism. A 7000-R irradiation of invaded material significantly decreased the virulence of Theileriae that had maintained their immunogenicity. Doses of 10,000 and 15,000 R inactivated large horned cattle theileirosis in suspensions of the internal organs of sick animals. (tr-auth)

8063 VARIATIONS IN GENETIC ARCHITECTURE AT DIFFERENT DOSES OF GAMMA RADIATION AS MEASURED BY LONGEVITY IN DROSOPHILA MELANOGASTER. Westerman, J. M.; Parsons, P. A. (La Trobe Univ., Bundoora, Australia). Can. J. Genet. Cytol.; 15: No. 2, 289-298(Jun 1973).

Longevity (as a measure of resistance to irradiation) was examined after exposure to different doses ^{60}Co γ rays in four inbred lines and their hybrids in D. melanogaster. The control data showed some additive and nonadditive effects. At 40, 60, 80, 100, and 120 krads, nonadditive effects were highly significant, but additive effects were significant only at 100 and 120 krads, in particular the latter. Thus, the genetic response varies with dose. Detailed genetic studies probably are simplest to carry out at high doses because of the importance of additive effects. (auth)

8064 EFFECTS OF GAMMA RADIATION ON THE CHROMOSOMES OF GRYLLIDAE (ORTHOPTERA). Lim, H. C.; Kevan, D. K.; Vickery, V. R. (McGill Univ., Montreal). Can. J. Genet. Cytol.; 14: No. 4, 753-761(Dec 1972).

Six species of Gryllidae (orthoptera), Gryllus assimilis, G. Bimaculatus, G. pennsylvanicus, Acheta domesticus, Scapipedus marginatus, and Allonemobius allardi, were subjected to gamma radiation treatment (dosages varied from 1000 rads to 2446 rads) in order to induce chromosomal abnormalities. Gamma radiation was found to affect development, survival, and reproduction. Effects of gamma rays were similar in all of the species studied, but sensitivity varied between the different species. (auth)

Radionuclide Effects (Internal Source)

Refer also to abstracts 7698, 7960, 7973, and 8072.

Man

8065 (COO-119-248, pp 378-400) CANCER INDUCTION IN MAN FROM INTERNAL RADIOACTIVITY. Mays, C. W. (Univ. of Utah, Salt Lake City). 31 Mar 1973.

In research in radiobiology.

The indicated malignancies have been induced in exposed persons by the following radionuclides and their decay products: ^{222}Rn–uranium miners–lung carcinomas; ^{226}Ra–dial painters–bone sarcomas and sinus carcinomas; ^{232}Th–thorotrast cases–liver cancers; ^{224}Ra–German patients–bone sarcomas; ^{32}P–polycythemia patients–leukemia; and ^{131}I–Marshall islanders–thyroid tumors. Each of these examples is discussed in turn. (auth)

8066 (NP-19898) MEASUREMENTS OF ^{55}Fe IN HUMAN BLOOD, NORWAY 1967–1969. Lekven, J. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). May 1971. 103p. Dep. NTIS (U. S. Sales Only) $7.25.

Iron-55 content in human blood was measured in 313 samples from different regions of Norway collected in 1967 and 1969. The samples were prepared by electroplating. In Southern Norway values of 2 to 5 nCi/l whole blood were found. The highest values were found among Lapps with 10 to 30 nCi/l. The radiation dose to the whole body was calculated to be 0.03 to 0.35 mrad/year. (auth)

8067 SKELETAL LOCATION OF RADIATION-INDUCED AND NATURALLY OCCURRING OSTEOSARCOMAS IN MAN AND DOG. Thurman, G. B.; Mays, C. W.; Taylor, G. N.; Keane, A. T.; Sissons, H. A. (Univ of Utah, Salt Lake City). Cancer Res.; 33: 1604-1607(Jul 1973).

A compilation of six major studies on the classification of naturally occurring and radiation-induced human and canine bone sarcomas showed that osteosarcoma was the most frequent type of bone sarcoma. The skeletal distribution of osteosarcomas induced by bone-seeking radionuclides in man and dogs was different from the distribution of naturally occurring osteosarcomas. (auth)

8068 DOSIMETRY OF GOLD-198 SEED IMPLANTS. Das, K. R. (Dept. of Atomic Energy, Bombay). Australas. Radiol.; 17: No. 3, 321-327(Sep 1973).

For single plane implants with gold seeds, assuming a matrix distribution for the seeds, the optimum separation of the matrix elements and the optimum ratio of the activity of the seeds in the area to that of those in the periphery were calculated, so that the uniformity of dose distribution is within ±10%. Area dosages were also computed and are tabulated. The dose variations in double plane implants and volume implants also were studied and the results are presented. Dosage graphs are given for both cases. The theoretical dose distributions were verified for a few implants experimentally using LiF thermoluminescence dosimeters. (auth)

8069 CANCER INDUCTION IN MAN FROM INTERNAL RADIOACTIVITY. Mays, C. W. (Univ. of Utah, Salt Lake City). Health Phys.; 25: No. 6, 585-592(Dec 1973).

The indicated malignancies have been induced in exposed persons by the following radionuclides and their decay products: ^{222}Rn–uranium miners–lung carcinomas; ^{226}Ra–dial painters–bone sarcomas and sinus carcinomas; ^{232}Th–thorotrast cases–liver cancers; ^{224}Ra–German patients–bone sarcomas; ^{32}P–polycythemia patients–leukemia; and ^{131}I–Marshall Islanders–thyroid tumors. Each of these examples is discussed in turn. (auth)

Animals

Refer also to abstract 8079.

8070 EXPERIMENTAL STUDIES ON THE CONTAMINATION OF LIVING BODIES BY THE INTAKE OF RADIOACTIVE SUBSTANCES (^{90}Sr, ^{89}Sr, ^{144}Ce) AND THEIR INFLUENCES, ESPECIALLY ON THE ACCUMULATION AND DISTURBANCES OF RADIOISOTOPE (RI) IN RODENTS. Iwabuchi, T. (Tohoku Univ., Sendai). Kyosai Iho; 22: No. 1, 23-52(Feb 1973). (In Japanese).

In report 1, rats were given ^{90}Sr at different doses (0.3, 1.0, 3.0 μCi/g) and different methods (intraperitoneally, orally) and the relationship between effects and contamination by ^{90}Sr of body organs and administration conditions was investigated. In Report 2, rabbits were given ^{89}Sr by different doses (0.1, 0.5 μCi/g) and different methods (subcutaneously, intravenously), and the relationship between influence of ^{89}Sr on development of the diameter of the incisor tooth and administration conditions was investigated. In Report 3, rabbits were given ^{90}Sr or ^{144}Ce and the effects on the number of leukocytes and dentification mechanism were investigated. In Report 1, ^{90}Sr distributed in organs was enhanced in accordance with increasing dose, showing higher amount in the hard tissue than in the soft tissue, and higher amount in the intraperitoneally injected group than in the orally administered group. In Report 2, a high amount of ^{89}Sr distribution was observed in the hard tissue, and all experimental groups showed reduction in weight. The group in which 0.1 μCi/g of ^{89}Sr was administered showed no remarkable difference by administration method, while the group in which 0.5 μCi/g of ^{89}Sr was administered showed remarkable weight reduction in the intravenously injected group. In the 0.1 μCi/g administered group, the influence on teeth growth by administration method was not remarkable, while in the 0.5 μCi/g administered group, remarkable reduction in diameter of the incisor teeth was noted in the intravenously administered group. In Report 3, the number of leukocytes decreased remarkably in accordance with increasing dose, and its recovery was prolonged in both ^{90}Sr and ^{144}Ce administered groups. On histopathological examination of the teeth, peridental tissue, bone marrow, etc., regressive degenerations, such as atrophic changes, and vacuole formation, tended to occur frequently in accordance with increasing dose. (JA)

8071 CHANGES IN THE LEUKOCYTIC SYSTEM OF RATS UNDER THE INFLUENCE OF ^{32}P ISOTOPE AND ASCORBIC ACID. Manowska, J. (Jagiellonian Univ., Krakow). Folia Biol. (Krakow); 21: No. 3, 305-312(1973).

Ascorbic acid elicits neutrophilia in young rats throughout the period of its action. In the first phase of the experiments, rats reacted to ascorbic acid with marked increase in the numbers of neutrophilic granulocytes, but reacted to isotope in the terminal experimental phase. Lymphocytes in rats reacted to ascorbic acid with depression of their numbers. Small lymphocytes were a sensitive indicator of the action of the stimuli used in the experiment. The decrease in small lymphocytes was accompanied by an increase in large lymphocytes. Eosinophils reacted with marked depression to ascorbic acid and to corpuscular radiation, and most strongly to the radioactive factor. Ascorbic acid stabilized the white blood cells. (auth)

Nuclide Kinetics and Toxicology

Refer also to abstract 7602.

Man

Refer also to abstracts 7982, 8065, 8178, 8180, and 8181.

8072 (AECL-4611) RECOMMENDED PROTECTIVE CLOTHING PRACTICE TO MINIMIZE RADIATION EXPOSURE. Legg, G. G. (Atomic Energy of Canada Ltd., Sheridan Park, Ontario. Power Projects). Oct 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

The practice of wearing protective apparel has been concerned mainly with reducing the tritium intake to the wearer; frequently the importance of external radiation is neglected. Consequently the internal dose is reduced, but often the total dose received is not the minimum value that could be obtained. The practice recommended here considers both the external radiation and the tritium concentration, and provides a fast and easy method for determining the amount of protection that should be worn to achieve minimum total radiation dose. (CA)

8073 (BNWL-tr-96) ELIMINATION BY PULMONARY LAVAGE, IN VIVO, OF INHALED PLUTONIUM OXIDE PARTICLES: DESCRIPTION OF TECHNIQUES USED. Nolibe, M. D. Translated by E. R. Appleby from Compt. Rend., Ser. D; 276: 225-228(1973). 9p. Dep. NTIS $3.00.

The use of in vivo lung washout appears to be the only therapeutic technique capable of eliminating inhaled toxic substances, particularly in the case of highly carcinogenic soluble radioactive particles. This therapeutic technique has recently been applied to man in the case of an accidental inhalation of plutonium oxide. The systematic utilization of such a technique has necessitated experiments on baboon monkeys in which atmospheres charged with plutonium oxide particles having a mean diameter of 5μ were inhaled. The washouts were effected without problems, and a rapid physiological recovery achieved. For an abstract of this paper from the original, see NSA volume 28, no. 24871. (FR)

8074 UPTAKE AND EFFLUX OF ^{86}Rb BY HUMAN BLOOD PLATELETS. Baadenhuijsen, H.; De Pont, J. J. H. H. M.; Daemen, F. J. M. (Univ., Nijmegen, Netherlands). Biochim. Biophys. Acta; 298: 690-701(1973).

The Na^+ and K^+ concentrations and the influx and efflux kinetics of $^{86}Rb^+$ in human blood platelets were studied. The passive membrane permeability of these platelets was studied in platelet rich plasma by means of a dialysis technique, thus avoiding harmful washing, centrifugation, and resuspension procedures. In platelets from platelet-rich plasma, $^{86}Rb^+$ influx and efflux are in equilibrium, while in platelets from concentrated suspensions the $^{86}Rb^+$ influx is decreased while the efflux is increased. This is correlated with a K^+ loss of 24% during a 1-h stay of platelets in concentrated suspensions. These observations indicate that platelets from platelet-rich plasma are in a better condition compared to platelets from concentrated suspensions, which are leaky and functionally inferior. The dialysis method described offers a new tool in the study of platelet function and possibly also of other single cell systems. (auth)

8075 CHANGES IN RESIDUAL ENCEPHALON ACTIVITY AFTER THE INJECTION OF A SOLUTION OF ^{169}Yb-LABELED DTPA INTO THE CEREBRO-SPINAL FLUID. de Tovar, G. (Centre Medico Chirugical Foch, Suresnes, France); Beaufils, F.; Collonge, M.; Koutoulidis; Zerbib, J. C.; Imbert, L.; Bonleu, M.; Joffre, H. J. Biol. Med. Nucl.; 8: No. 31, 26-32(1973). (In French).

The value of the residual ^{169}Yb activity was determined a few weeks after a suboccipital injection of this nuclide into the cerebrospinal fluid. The absorbed dose is evaluated at certain points of the skull from the activity values measured. (FR)

8076 THYROID ^{131}I UPTAKE MEASUREMENT AND THE DETERMINATION OF EFFECTIVE HALF-LIFE OF ^{131}I IN PATIENTS WITH THERAPEUTIC DOSES. Kakehi, H.; Saegusa, K.; Tateno, Y. (Chiba Univ., Japan). pp 31-39 of Thyroid Radionuclide Uptake Measurements. Vienna; International Atomic Energy Agency (1973).

From conference on thyroid radionuclide uptake measurements; Vienna, Austria (17 May 1971).

Comparative studies of uptake and effective half-life of ^{131}I in the thyroid in patients receiving diagnostic and therapeutic doses of the radioisotope are described. Uptake of diagnostic doses was measured conventionally. Uptake of therapeutic doses was measured using the same scintillation detector at a working distance of 150 cm and a pulse-height analyzer with a narrow window aligned on the 0.364 MeV peak in the gamma-ray spectrum. The results showed considerable individual variation. The mean values for 24-hr uptake of diagnostic and therapeutic doses were 71.5% and 65.6% respectively, the mean difference being 5.9% and its standard deviation 15%. The effective half-life was often shorter for therapeutic than for diagnostic doses and was further shortened by repeated therapy, the mean values after one, two, and three therapeutic doses being 5.3 days, 4.5 days, and 3.3 days, respectively. Accurate assessment of the radiation dose to the thyroid in the individual case requires direct measurement of the uptake and effective half-life. (auth)

8077 CREATININE USED AS A REGISTRATION MARK TO DIMINISH THE STATISTICAL ERROR IN THE DETERMINATION OF ^{210}Po CONTENTS IN THE BODY. Demina, S. E.; Ermilov, A. P.; Kryazhimskaya, T. P.; Margulis, U. Ya.; Molokova, N. T.; Sergeeva, A. D.; Krushch, V. T. (Inst. of Biophysics of the Ministry of Public Health, Moscow). Gig. Sanit.; No. 9, 53-55 (Sep 1973). (In Russian).

It was demonstrated that in order to diminish the statistical error in the determination of ^{210}Po contents in the body on the basis of the analysis of a single portion of urine, it is necessary to carry out a simultaneous analysis of this portion of urine for the contents of creatinine. In case of field use of this method for the purpose of large-scale examination of local population, statistical data should be collected concerning the mode of creatinine introduction under definite conditions of living and work. (auth)

8078 ^{90}Sr IN THE BONES OF CZECHOSLOVAK CITIZENS FROM 1964 TO 1969. Brezik, A.; Kunz, E. (Inst. of Hygiene and Epidemiology, Prague). Cas. Lek. Cesk.; 112: No. 24, 750-754(1973). (In Czech).

During the years 1964 to 1969, the content of ^{90}Sr and Ca was systematically examined in the bones of deceased subjects of various age groups. The concentration of ^{90}Sr in relation to Ca content showed significant dependence on the subjects' ages, which in turn is connected with the age-dependent differences

in metabolism of ^{90}Sr and Ca and to differences in ^{90}Sr intake during individual years. In the course of the study, a gradual decrease in this intake in the food occurred. These changes are most markedly reflected in the ^{90}Sr deposition in the bones of the youngest children and infants. The average dose inputs from ^{90}Sr deposited in the human bones from radioactive fallout, did not, in the years of the maximum fallout, exceed 10 to 15 mrad yearly and represented but a small fraction of dose inputs from the natural background. (auth)

Animals

Refer also to abstracts 7717, 8070, 8135, 8151, and 8179.

8079 (COO-119-248) RESEARCH IN RADIOBIOLOGY. Annual Report of Work in Progress in the Internal Irradiation Program. Dougherty, T. F. (Utah Univ., Salt Lake City (USA). Coll. of Medicine). 31 Mar 1973. Contract AT(11-1)-119. 400p. Dep. NTIS $22.00.

Separate abstracts were prepared for 18 of the 22 papers in this progress report. The other papers discuss methods used in the work and the effects of various chelating agents on the animals. (ERB)

For abstracts of individual papers see: 8065, 8080–8093, and 8131–8133.

8080 (COO-119-248, pp 9-109) INJECTION TABLES. 31 Mar 1973.

In research in radiobiology.

Injection data from radioisotope toxicity studies in dogs are presented in tabular form. Toxicity studies are distinguished from other studies where animals are sacrificed at specified times for metabolic or pathological tests. The radioisotopes studied were ^{226}Ra, ^{239}Pu, ^{228}Ra, ^{228}Th, ^{90}Sr, and ^{241}Am. (ERB)

8081 (COO-119-248, pp 110-140) SCIENTIFIC ADVANTAGES IN THE USE OF THE BEAGLE IN LONG TERM RADIOBIOLOGICAL STUDIES. Mays, C. W.; Jee, W. S. S.; Nabors, C. J. Jr.; Taylor, G. N.; Stevens, W.; Dougherty, J.; Christensen, W. R.; Dougherty, T. F. 31 Mar 1973.

In research in radiobiology.

The beagle was originally chosen as an experimental animal in radiobiology primarily because of its relatively long lifespan and metabolic similarity to man. Some obvious scientific advantages in using the beagle are: skeletal similarity to man; important jaw syndrome induced in man and beagles, but not rodents; relevant radiographic information; osteosarcoma location; possible difference in shape of dose-response: rodents vs large mammals; unique sex difference in bone sarcoma induction: mice vs humans and beagles; growth dynamics of osteosarcomas; liver retention of ^{239}Pu; advantage in obtaining sequential blood samples in beagles; corticosteroid production similarity between man and beagle; transaminase and alkaline phosphatase similarities between man and beagle; and advantage of larger organ size in radionuclide distribution studies. (auth)

8082 (COO-119-248, pp 156-162) CALIFORNIUM RETENTION IN BEAGLES DURING THE FIRST TWO YEARS AFTER INJECTION. Lloyd, R. D.; Mays, C. W.; Atherton, D. R.; Taylor, G. N.; McFarland, S. S.; Williams, J. L. 31 Mar 1973.

In research in radiobiology.

Retention of californium in the total body and in the liver of 21 beagles injected with ^{249}Cf and 19 beagles injected with ^{252}Cf was determined by total-body and partial-body counting techniques for burden times of more than 2 years. Total-body retention was as if 23.8% of the injected Cf were retained with a biological half-time (T_b) of about 1.6 days and 76.2% with a T_b of about 3129 days = 8.6 years. Liver retention was as if 9.6% of the injected Cf were retained with a T_b of 2.5 days and 18.5% with a T_b of 1191 days = 3.3 years. It appeared that there were no important differences between these two californium isotopes in either total-body or liver retention. (auth)

8083 (COO-119-248, pp 163-177) CURIUM EXCRETION, RETENTION, AND DISTRIBUTION STUDIES IN BEAGLES. Lloyd, R. D.; Atherton, D. R.; Mays, C. W.; McFarland, S. S.; Williams, J. L. 31 Mar 1973.

In research in radiobiology.

The metabolism of curium was studied in 5 young adult beagles from 0 to 57 days after the intravenous injection of $^{244}Cm + ^{243}Cm$ in citrate buffer. Total excretion during the first 3 weeks after injection was mainly urinary. Of the entire Cm eliminated in this 3 week collection period, nearly ⅔ appeared in the first day's urine. About 5 times more Cm was excreted in the urine than in the feces on the first day. Following this, however, partitioning of Cm between urine and feces in the daily excretion was more nearly equal. A combination of total-body and partial-body counting of the living dogs utilizing the 209, 228, and 278 keV gamma rays of ^{243}Cm indicated that at a week after injection about 35% of the injected Cm was deposited in the liver and about 53% was in non-liver tissue (mainly skeleton). Three dogs were sacrificed at 6, 13, and 20 days after injection. Although the liver and skeleton accounted for the bulk of the retained curium, some other tissues exhibited significant Cm concentrations, particularly the thyroid. Urinary excretion, retention, and tissue distribution of injected curium were similar to that of inhaled curium in 24 beagles. (auth)

8084 (COO-119-248, pp 178-185) EARLY RETENTION AND DISTRIBUTION OF CURIUM IN SOFT TISSUES AND BLOOD OF THE BEAGLE. Atherton, D. R.; Stevens, W.; Bruenger, F. W. 31 Mar 1973.

In research in radiobiology.

Following intravenous administration of curium to the beagle, the concentration of the nuclide in circulating blood diminished very rapidly, and after 2 days the concentration was of the order of 0.4% per kg of blood. Soft tissue concentration was highest in the liver, followed by thyroid, kidney, dura mater, and lymph nodes. The concentrations in other soft tissues were less by substantial factors. (auth)

8085 (COO-119-248, pp 186-200) EARLY SUBCELLULAR DISTRIBUTION OF CURIUM IN CANINE LIVERS. Bruenger, F. W.; Grube, B. J.; Atherton, D. R.; Stevens, W. 31 Mar 1973.

In research in radiobiology.

Previous studies of the subcellular distribution of ^{239}Pu, ^{241}Am, and $^{249,252}Cf$ in canine livers were extended to include $^{243,244}Cm$. Beagles were injected with 3 μCi of the nuclide in citrate solution of pH 3.5. Following injection liver specimen were obtained at 0.092 and 47 days by surgical liver biopsy and at 6, 13 and 30 days at autopsy. As observed with other nuclides, curium in the liver was first associated with soluble liver proteins, mainly ferritin, and was found later in increasing concentrations in subcellular organelles. The highest concentration was found in the crude mitochondrial fraction and somewhat less in the crude lysosomal fraction. A considerable part of the nuclide remained in the cytosol. Sucrose density gradients showed a variable relation between the lysosomal enzyme marker activity and the nuclide concentration. Heavy subcellular organelles other than lysosomes (probably mitochondria) must, therefore, be involved in the binding of the nuclide. With respect to liver retention and subcellular distribution, curium occupies a position between Am(III) and Cf(III). However, it resembles Am(III) more closely than Cf(III). (auth)

8086 (COO-119-248, pp 201-212) COMPARISON OF THE INTRACELLULAR DISTRIBUTION OF ^{239}Pu, ^{241}Am AND ^{249}Cf IN LIVERS AFTER INTRAVENOUS ADMINISTRATION. Stevens, W.; Atherton, D. R.; Stover, B. J.; Bruenger, F. W. 31 Mar 1973.

In research in radiobiology.

The intracellular distribution in livers of beagles injected intravenously with either ^{239}Pu(IV), ^{241}Am(III), ^{249}Cf(III), or ^{252}Cf(III) in 0.08 M citrate, pH 3.5 was studied serially. Liver homogenates were fractionated by differential centrifugation. A mitochondrial fraction was obtained by centrifugation at 60,000 g-min, a lysosomal fraction at 8×10^5 g-min and a cytosol at 6×10^6 g-min. Initially all three nuclides were found in the cytosol and mostly associated with ferritin. Considerably higher concentrations of americium and californium than plutonium remained in the cytosol at progressively longer times after administration. The order of the rate of removal of nuclide from the cytosol was Pu $\gg$ Cf > Am. As the nuclide was removed from cytosol it became associated with subcellular organelles. No constant relationship was observed between concentration of nuclide and mitochondrial or lysosomal marker. The ratio of nuclide to lysosomal marker was consistently higher in the mitochondrial fraction than in the lysosomal fraction. However, we have not been able to demonstrate significant contamination of the mitochondrial fraction with lysosomes using electron microscopy. It is concluded from this study that mitochondria and lysosomes and possibly other organelles are involved with nuclide binding in canine liver cells. (auth)

8087 (COO-119-248, pp 213-228) BINDING OF ^{241}Am BY BONE PROTEIN. Bruenger, F. W.; Grube, B. J.; Atherton, D. R.; Stevens, W. 31 Mar 1973.

In research in radiobiology.

A study to characterize some details involved in the binding of actinide elements to skeletal tissue was initiated. The studies were limited to ^{241}Am as a model representative of the actinide series. Experiments were carried out first with mature skeletal tissue obtained from a beagle injected with ^{241}Am. A protein fraction of high but as yet undetermined molecular weight, which was associated with ^{241}Am, was extracted from the whole bone homogenate. Extracts were also prepared from embryonic or neonatal skeletal tissue of rats and beagles. These extracts were incubated in vitro with ^{241}Am and ^{90}Sr. These experiments showed that beginning with the onset of ossification a protein of molecular weight

≈500,000 emerged that had a high affinity for ^{241}Am. With increasing time after conception another protein of very high molecular weight emerged to which the nuclide had an affinity that was even higher than the affinity for the protein of molecular weight ≈5 × 10^5. ^{90}Sr exhibited a much lower affinity for both of these proteins, but qualitative similarities existed between the uptake of ^{241}Am and ^{90}Sr by both of these proteins. The protein of molecular weight ≈5 × 10^5 and the very high molecular weight protein both gave positive tests for glycoprotein and sialic acid. (auth)

8088 (COO-119-248, pp 229-243) RETENTION OF ^{239}Pu IN THE ULNA OF THE BEAGLE COMPARED WITH RETENTION IN THE HUMERUS AND THE THIRD LUMBAR VERTEBRA. Atherton, D. R.; Stover, B. J. 31 Mar 1973.

In research in radiobiology.

The initial deposition of ^{239}Pu and the rate of decrease in retention were both higher in bones with a relatively greater amount of trabecular bone. For this reason the ulna, which has relatively less trabecular bone, was chosen for an extensive comparison with the humerus and third lumbar vertebra. These three bones were obtained from 40 beagles at dose levels from 0.00064 to 0.095 μCi ^{239}Pu/kg (P0.1 to P2) and at times from 35 to 4549 days after injection. Analyses showed that the initial concentration of ^{239}Pu in the ulna was about 25% that in the other two bones. Retention of ^{239}Pu in the ulna was approximately constant over the 12.5 year period. In contrast, retention in both the humerus and third lumbar vertebra decreased during the first several years and then approached approximately constant values. A kinetic model for the observed retention has been formulated. (auth)

8089 (COO-119-248, pp 244-254) JEE-MILLER DETAILED NEUTRON-INDUCED AUTORADIOGRAPHY OF ^{239}Pu BONES. Jee, W. S. S.; Dell, R. B.; Kimmel, D.; O'Toole, J. J.; Clark, L. Jr. 31 Mar 1973.

In research in radiobiology.

Neutron-induced autoradiography (NIAR) of bones from beagle dogs injected with as little as 0.0006 μCi of ^{239}Pu/kg body weight is now possible. Undecalcified 7 μ thick sections are affixed to Lexan film and irradiated with thermal neutrons at the Ames Laboratory Research Reactor, Iowa State University, Ames, Iowa, or the Massachusetts Institute of Technology Research Reactor, Massachusetts Institute of Technology, Cambridge, Massachusetts, for about one month. Recent improvements in developing techniques have given reproducible films showing fission fragment tracks upon a bone image. This method allows rapid, accurate localization of the ^{239}Pu in bones from animals receiving very small amounts of ^{239}Pu. (auth)

8090 (COO-119-248, pp 288-297) EVALUATION OF PROGRESSIVE PERIODONTAL DISEASE IN BEAGLES. Kimmel, D. B.; Woodbury, L. A.; Kirk, F.; Dell, R. B.; Jee, W. S. S. 31 Mar 1973.

In research in radiobiology.

Quantitative histological aspects and the distribution of ^{45}Ca in the interradicular and interdental hard tissue areas of the jaw from four beagles were studied. These values will be part of the baseline data for the study of beagles placed on periodontal disease-inducing diet. The percent bone in the various areas is as follows: the interradicular area of the mandibular first molar, 31 to 39%; the interdental area between the mandibular first molar and the fourth premolar, 52 to 72%; the interradicular area of the mandibular third premolar, 73 to 77%; the interdental area between the mandibular second and third premolars, 72 to 87%; the interradicular area of the maxillary first molar, 33 to 35%; and the interdental area between the maxillary first molar and the third premolar, 53 to 60%. Counts of hot spot distribution indicate that 20 to 35% of the interdental and interradicular bones were occupied by hot spots. The ratios of hot spots/diffuse ranged from 5 to 7. (auth)

8091 (COO-119-248, pp 308-316) PLUTONIUM-239 AND THE STIMULATED PERIODONTAL LIGAMENT CELLS. Hess, J.; Jee, W. S. S. 31 Mar 1973.

In research in radiobiology.

Following a single i.p. injection of 3.0 μCi ^{239}Pu/kg body weight, the quantity of ^{239}Pu on the alveolar bone surface mesial to the periodontal ligament (PDL) of the maxillary first molar of male Sprague-Dawley rats increased from 1 to 9 days, then decreased by 15 days. At 15 days post-injection, the amount continued to decrease for 22 hours in both an orthodontically stimulated area and a non-stimulated area in the opposite jaw of the same animal. However, the amount continued to fall in the stimulated PDL until 48 hours post-stimulation while the non-stimulated side remained constant from 22 to 48 hours. The labeling index of the stimulated PDL fibroblasts of control and ^{239}Pu-injected female Sprague-Dawley rats rose to a peak of 12% at both 22 and 27 hours post-stimulation. Regional analysis of labeling index divided the PDL fibroblasts into at risk and safe groups. The "at risk" cells showed a labeling index of 10% at 22 hours compared to the cells of the same area in a control animal whose labeling index was 22%. The "safe" cells showed a labeling index of 15% vs a labeling index of 10% in corresponding controls. In stimulated controls, the number of osteoblasts increased by three-fold after 48 hours, while the number of osteoclasts decreased to zero. In stimulated ^{239}Pu-treated animals, the number of osteoblasts doubled in 48 hours, while the number of osteoclasts doubled also. (auth)

8092 (COO-119-248, pp 317-335) HEMATOLOGIC CHANGES FOLLOWING ^{239}Pu INJECTION IN ADULT ST. BERNARDS AND IMMATURE BEAGLES. Dougherty, J. H.; Woodbury, L. A. 31 Mar 1973.

In research in radiobiology.

The hematologic changes following a single intravenous injection of ^{239}Pu in young adult St. Bernards and 3 month old beagles are reported for the first year following injection. The amounts of ^{239}Pu injected ranged from 0.005 to 0.3 μCi/kg in the 12 St. Bernards and from 0.3 to 3.0 μCi/kg in the 20 beagle pups. The dose levels selected were comparable to those in the adult beagles injected in the laboratory. There were no significant alterations in erythrocytes in any of the dose levels in either the St. Bernards or beagle pups. A dose-dependent leukopenia was found in St. Bernards receiving the two highest dose levels (0.1 and 0.3 μCi/kg), which was sustained over the first year. The pattern and degree of cell depression was quite similar to that found in adult beagles. The beagle pups given the highest dose level (0.3 μCi/kg) had a leukopenia and lymphophenia that was not as marked as found in adult beagles receiving the same amount of ^{239}Pu. The increase in skeletal mass of the pups during growth, a more rapid burial of ^{239}Pu within bone volume, and perhaps, a greater capacity of the immature hematopoietic system to recover may be possible reasons for this difference in hematologic toxicity of the injected plutonium. (auth)

8093 (COO-119-248, pp 370-377) DOSE-RESPONSE RELATIONSHIPS FOR THE INDUCTION OF BONE SARCOMAS BY β AND α-EMITTERS AND THE EFFECT OF DOSE-RATE ON DELAYED SOMATIC EFFECTS FROM LOW LET AND α-RADIATION. Mays, C. W.; Lloyd, R. D. 31 Mar 1973.

In research in radiobiology.

The dose-response relationship for the induction of bone sarcomas by long-lived β emitters is strongly sigmoid. For α emitters, the relationship appears linear for rodents, but may be sigmoid for man and dog. In 10 intercomparisons of life shortening and the induction of neoplasms from low LET radiation, the effect per rad at low dose-rates averaged 0.2 of that at high dose-rates. In contrast, for α-irradiation from ^{224}Ra, the incidence of bone sarcomas from a given dose increased as the dose-rate was lowered. (auth)

8094 ACCUMULATION OF ^{169}Yb-CITRATE IN MALIGNANT TUMOR. Higasi, T. (Kanagawa Dental Coll., Yokosuka, Japan); Fujimura, T.; Nakayama, Y.; Hisada, T.; Tomura, K. Kaku Igaku; 10: No. 1, 27-35(Feb 1973). (In Japanese).

The uptake of ^{169}Yb-citrate by Ehrlich's tumor-bearing mice and Yoshida sarcoma-bearing rats was studied. The excretion following intraperitoneal injection of $^{169}YbCl_3$ and ^{169}Yb-citrate was examined. The excretion of ^{169}Yb-citrate was significantly and consistently greater than that of $^{169}YbCl_3$. When the ^{169}Yb-citrate containing carrier dose of 0.5 mg stable $YbCl_3$ was injected in Ehrlich's tumor-bearing mice, the excretion of the ^{169}Yb-citrate was greatly decreased. In addition, when the ^{169}Yb-citrate containing carrier dose of 0.5 mg stable $CaCl_2$ was injected in Ehrlich's tumor-bearing mice, the excretion of the ^{169}Yb-citrate was somewhat decreased. Scintigrams taken 48 hrs after the administration of 150 μCi of ^{169}Yb-citrate in Yoshida sarcoma-bearing rats showed high uptake in bone and in tumor. Whole-body autoradiograms taken 48 hrs after the administration of 100 μCi of ^{169}Yb-citrate in Ehrlich's tumor-bearing mice showed high uptake in bone but the uptake in other organs was poor. Furthermore, ^{169}Yb-citrate was obviously taken up by the active inflammatory lesions in the femoral region of rats as well as the tumor tissue. A comparison of the accumulation of ^{169}Yb-citrate with the accumulation of ^{67}Ga-citrate in the Ehrlich's tumor-bearing mice was performed. It was found that ^{67}Ga-citrate was better incorporated in Ehrlich's tumor than ^{169}Yb-citrate. Clinically, because ^{169}Yb-citrate strongly accumulates in the vertebra as well as in tumor tissue, it is impossible to diagnose cancerous lesions of the mediastinum. (auth)

8095 SOME FACTORS AFFECTING THE IN VITRO RATES OF DISSOLUTION OF RESPIRABLE PARTICLES OF RELATIVELY LOW SOLUBILITY. Kanapilly, G. M.; Goh, C. H. T. (Lovelace Foundation for Medical Education and Research, Albuquerque, NM). Health Phys.; 25: No. 3, 225-237(Sep 1973).

The rate of dissolution of a relatively insoluble material deposited in the lower respiratory tract (LRT) is an important parameter in determining its relative retention in the LRT and its translocation to other tissues. Dissolution conditions may affect the rate of dissolution of a relatively insoluble material. The effects of some of these factors on the in vitro rates of dissolution of some radioactive aerosol particles were studied. Included among these factors were particle size, solvent composition, solvent flow rate, temperature of the dissolution system, and method of measurement. Experimental conditions for the measurement of the in vitro rates of dissolution of relatively insoluble aerosol particles for comparison with in vitro dissolution rates in the LRT are discussed. (auth)

8096 DISTRIBUTION OF ^{13}C AND ^{12}C ISOTOPES IN RAT HEPATIC CELLS. Mosora, F.; Lacroix, M.; Duchesne, J. (Univ., Liege). Compt. Rend., Ser. D; 277: No. 2, 237-238(9 Jul 1973). (In French).

The $^{13}C/^{12}C$ isotopic ratios characteristic of the different hepatic cell organoids of rats were determined. This ratio presents a very unusual distribution in the nucleus, the ^{12}C concentration being significantly greater than that of ^{13}C. (FR)

8097 EFFECT OF AUTONOMIC NERVE STIMULANTS ON THE DISTRIBUTION OF ^{99m}Tc-PERTECHNETATE. Nakamura, J. (Kanazawa Univ., Japan). Kanazawa Irigaku Sosho; 91: 51-68 (Jan 1972). (In Japanese).

This study was performed in anticipation of an improvement of radioisotopic examination with ^{99m}Tc-pertechnetate and of changing organ accumulation of ^{99m}Tc-pertechnetate with administration of autonomic nerve stimulants. Changes of organ accumulation of ^{99m}Tc-pertechnetate were followed at 15, 30, 60, 120, 180, and 300 min after administration of autonomic nerve stimulants. Using rats, the accumulation of ^{99m}Tc-pertechnetate in the thyroid gland, parotid gland, sudmandibular gland, brain, liver, spleen, kidney, and blood were determined. An organ of highest accumulation of ^{99m}Tc-pertechnetate was the thyroid gland. Continuously, in the liver, kidney, parotid gland, submandibular gland, spleen, and brain, the accumulation became low and the accumulation in the blood was relatively high. In control group, the all organ accumulation of ^{99m}Tc-pertechnetate were highest at 30 min after injection into abdominal cavity and after 120 min gradually decreased. In the group administered noradrenalin (sympathetic nerve stimulant) at 15 min before injection of ^{99m}Tc-pertechnetate, the accumulation of the thyroid gland, brain, liver, and kidney decreased early. In the group of administered noradrenalin at 15 min before sacrificing rat, the uptake of only the brain decreased early. In the group administered vagostigmin (parasympathetic nerve stimulant) at 15 min before injection of ^{99m}Tc-pertechnetate, accumulation of the submandibular gland, parotid gland, and kidney decreased. In contrast with these, the accumulation in the liver rose. Also in the group administered vagostigmin at 15 min before sacrificing rat, a high accumulation in the liver was also revealed and kept for relative long period. (auth)

8098 DATA. Section I. Milk and Food. Radiat. Data Rep.; 14: No. 10, 587-599(Oct 1973).

Data are presented on the content of ^{131}I, ^{137}Cs, ^{89}Sr, and ^{90}Sr in milk samples collected at various locations in the USA during June, 1973. Data are also included on the content of ^{137}Cs and ^{90}Sr in milk samples collected in the USA, Canada, and Central and South America during July, 1972, through June, 1973. (HLW)

8099 BONE MINERAL METABOLISM IN MICE AFTER FRACTURE OF TIBIAE, DOUBLING LABELING WITH ^{47}Ca AND ^{224}Ra. Guenzel, I.; Mueller, W. A. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neurnberg, Ger.). Biophysik; 10: No. 3, 267-272(1973).

The turnover of ^{47}Ca and ^{224}Ra was studied in callus of both tibiae and bone samples of knees, femora, vertebral column and skull by γ-spectrometric measuring methods. These measurements were correlated with histological and α-autoradiographic studies. Both radionuclides showed a sharp increase of retention in the fracture callus 5 to 10 days after fracturing. This effect was much greater for ^{47}Ca than for ^{224}Ra. Radiotoxic consequences are discussed for ^{224}Ra.

8100 SUBCELLULAR IDENTIFICATION OF EXOGENOUS PARTICLES BY HIGH-VOLTAGE ELECTRON MICROSCOPY. Adee, R. R.; Laidler, J. J. (Battelle Pacific Northwest Labs., Richland, WA). Amer. Ind. Hyg. Ass. J.; 34: No. 11, 507-511 (Nov 1973).

Animals were exposed to particles of asbestos, Cr_2O_3, NiO, and $^{239}PuO_2$ by either aerosol inhalation or injection. High-voltage electron microscopy was used to obtain diffraction images, and stereopairs of electron micrographs were used to identify and localize specific particles in cells. (auth)

8101 AFFINITY OF ^{253}Es FOR TUMOR TISSUE. Hayes, R. L.; Rafter, J. J.; Washburn, L. C.; Byrd, B. I. (Oak Ridge Associated Universities, Inc., TN). Nature (London) New Biol.; 246: No. 149, 23-25(7 Nov 1973).

A study was made of the tissue distribution of ^{253}Es injected as citrate (~ 10 μCi ^{253}Es kg^{-1}), or various chelates into rats bearing Morris 5123 hepatomas and RFT tumors, and mice with transplanted P-1798 lymphosarcomas and Ca-755 adenocarcinomas. Tissue distribution of intravenously administered ^{253}Es-citrate was essentially complete at 4 h and ^{253}Es appeared to have an affinity for 5123C hepatomas. Tumor to non-tumor ratios in animals bearing 5123C were generally quite high (up to 96.0 in muscle) at 1 day except for liver, kidney, and bone. The other tumors showed poorer affinities, although the tumor to muscle and tumor to blood ratios were relatively high. The ^{253}Es concentration in the kidney could not be reduced by the use of more citrate or other chelating agents. However there was some enhancement of tumor to non-tumor ratios for spleen, marrow, and blood with higher doses of citrate, or the use of nitrilotriacetic acid (NTA) or hydroxyethyliminodiacetic acid (HEIDA). (UK)

Plants

8102 UPTAKE OF RADIOACTIVE STRONTIUM AND CESIUM IN RICE PLANTS. I. Accumulation of Sr and Cs in Rice Grains Through Roots. Kodaira, K.; Tsumura, A.; Kobayashi, H. (National Inst. of Agricultural Sciences, Tokyo). J. Radiat. Res.; 14: No. 1, 31-39(Mar 1973).

Water-cultured rice plants were exposed to ^{89}Sr or ^{137}Cs through roots for five days at their various growth stages and continued to grow until harvest. The harvested grains were radiochemically analyzed and the concentration factors were calculated. The maximum uptake of ^{137}Cs in the grains was found at the booting stage, while that of ^{89}Sr was at the flowering stage. The Cs uptake was 400 times higher at the booting stage, and 30 times at the flowering stage than those with Sr. The growth stage dependency of the uptake of Sr and Cs was the most important factor for a selective enrichment of Cs in rice grains. The specific affinity of Cs to cell sap and that of Sr for membrane substances of rice grains probably caused a selective redistribution inside the plant body. (auth)

Microorganisms

8103 HOW DO USEFUL AND HARMFUL TRACE ELEMENTS OCCUR IN THE FOOD CHAIN. Broda, E. (Univ., Vienna). Naturwiss. Rundsch.; 26: No. 9, 318-389(1973). (In German).

The metabolism of trace elements is reviewed. Toxic trace elements play an important role. The manner in which the trace element penetrates into the cell is reported. Among the trace elements, the radioactive ones are of particular importance as they are always toxic. The non-radioactive harmless substances such as strontium are particularly critical in their radioactive form, as they are stored in bones as a result of their chemical similarity to calcium. A suggestion of how the enrichment of toxic trace elements in microorganisms can regenerate water is made. (GE)

8104 RECOVERY OF HEAVY METALS BY MICROBES. Chiu, Y. S. London, Ont.; Univ. of Western Ontario (1973). National Library of Canada, Ottawa.

Thesis (Ph. D.).

Microbes resistant to heavy metals (uranium, strontium, titanium, silver, and platinum) were isolated. The major isolates were filamentous fungi; two were used in the further studies. These were Penicillium C-1 and Penicillium C-2. The former culture was characterized by coarse pellet formation when grown on glucose medium, whereas the latter grew only in a dispersed or mycelial form. Both Penicillium cultures showed significant growth in basal medium or when grown on the same medium containing heavy metals, such as uranium and strontium, at concentrations of 100 ppm. These two cultures were able to take up 70% of the uranium when the uranium concentration in the medium was at 100 ppm. Of the two cultures, the most complete study was done with culture C-1 particularly as it relates to uranium. Uranium uptake by culture C-1 was affected by many factors such as pH, temperature, age of mycelia, external uranium concentration, etc. Among these factors, the relationship of temperature and age of mycelia to uranium uptake appeared to be most associated with physiological conditions of cells. Further studies indicated that the uranium uptake by culture C-1 involved adsorptive uptake as well as biologic involvement. Of the total uptake the rapid adsorptive uptake during the first 5 minutes accounted for about at least 50%. It may be concluded that uranium was also involved in certain biological function,

and at least part of the uranium taken up formed some type of complex with the membrane structure, possibly in the form of uranium enzyme complex. (Diss. Abstr. Int., B)

New Tracer Techniques

Refer also to abstracts 7605, 7910, 7912, 7938, 8075, 8090, and 8097.

8105 (CONF-730627-) PROCEEDINGS OF THIRD SYMPOSIUM ON SHARING OF COMPUTER PROGRAMS AND TECHNOLOGY IN NUCLEAR MEDICINE, MIAMI, FLORIDA, JUNE 15–16, 1973. McClain, W. J.; Maskewitz, B. F. (comps.). (Oak Ridge National Lab., Tenn. (USA)). 1973. 263p. Dep. NTIS $7.60.

Separate abstracts were prepared for 27 papers presented at this symposium. Abstracts of two papers appeared in NSA previously as numbers 28: 10,910 and 28: 21,837. (CH)

For abstracts of individual papers see: 7911, 7938, and 8106–8130.

8106 (CONF-730627-, pp 1-10) FLOW AND DIFFUSION IN THE MYOCARDIUM: MODELLING OF THE CONVECTION-DIFFUSION INTERRELATIONSHIPS GOVERNING THE USE OF SOLUTE WASHOUT FOR ESTIMATING BLOOD FLOW. Bassingthwaite, J. B.; Knopp, T. J.; Yipintsoi, T. (Mayo Graduate School of Medicine, Rochester, MN). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

A broad conceptual approach to the investigation of passive transcapillary exchanges is described, and illustrated by experiments on isolated blood-perfused dog hearts. Tracers were injected into the coronary inflow; responses recorded were either concentration-time curves in the coronary effluent or, for gamma-emitting tracers, residue function curves using detectors over the heart. Firstly, a region of flow-limited exchange is demonstrated when the curves recorded for a specific tracer are similar in shape at different flows, F; i.e., the fractional escape rate or clearance at a particular level on the residue function curve is directly proportional to F. Similarity occurred for albumin-bound indocyanine green dye, remaining intravascular, and for ^{123}I-antipyrine, distributed throughout tissue water, over a 3-fold range of flows. In a region where the ratio of convective velocity (flow) to diffusive velocity (permeability = D_R = diffusivity radially from the flow stream) is higher, then the extraction of intravascular sodium or other partially permeability-limited solutes diminishes at higher flows, so that curves at different flows are dissimilar. At still higher ratios, radial diffusivity is the sole limitation. At lower flows, or with rapidly diffusible tracers longitudinal diffusion, D_L, from inflow to outflow, or counter-current exchange, is significant relative to flow. After intraarterial injection, particularly at low flows, highly diffusible heat, ^{133}Xe, and THO have abnormally high early escape rates indicating diffusional shunting, and correspondingly low rates late on the washed out curve. In the lowest flow regime, where diffusion is relatively so rapid that tracer concentration throughout the organ is uniform, washout would be monoexponential; this region apparently does not exist at flows compatible with viability. For the estimation of flow, indicator washout curves should show similarity. (auth)

8107 (CONF-730627-, pp 11-14) SAAM 25: A GENERAL COMPUTER PROGRAM FOR FITTING NON-LINEAR FUNCTIONS. Shames, D. M. (Univ. of California, San Francisco). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

The Simulation, Analysis, and Modelling computer program (SAAM) developed by Berman and Weiss at the National Institute of Health is generally used to fit sets of linear or non-linear differential equations describing compartmental models to data. A short description is given of the use of SAAM to fit any nonlinear function of one or two independent variables. An example of the technique using SAAM to fit a particular non-linear mathematical function, the single event resolving time function, is described. (auth)

8108 (CONF-730627-, pp 15-30) QUANTITATIVE RADIOISOTOPE ANGIOCARDIOGRAPHY. Kirch, D. L. (Veterans Administration Hospital, Denver); Steele, P. P.; Metz, C. E. 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973)

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

The introduction of Anger γ camera systems, which are interfaced to dedicated mini-computers for performing very high count rate dynamic blood flow studies has added new dimensions to quantitative radioisotope angiocardiography. Given the ability to introduce a bolus of activity into the right or left atrium of the heart and acquire the radionuclide image data very rapidly for the following few seconds, it is possible to apply pulsatile modeling concepts to determine cardiac output, total, forward, and regurgitant ejection fractions, and end-diastolic and end-systolic volumes. The application of such a model to radioisotope angiocardiographic data is discussed. (auth)

8109 (CONF-730627-, pp 31-52) DEVELOPMENT OF A PULSATILE COMPARTMENTAL MODEL OF THE CARDIOPULMONARY CIRCULATION AND ITS APPLICATION TO THE ANALYSIS OF DATA FROM QUANTITATIVE RADIOCARDIOGRAPHY. Castellana, F. S.; Drago, J. A.; Pierson, R. N. Jr.; Dagan, J.; Lidofsky, L. J. (Columbia Univ., New York). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

Recent studies of cardiopulmonary circulation with the Anger gamma camera have demonstrated the possibility and potential of truly quantitative radiocardiography. Simultaneous measurements of the activity-time functions of an injected radioactive tracer in discrete heart-lung regions have been made available, and the proven feasibility of achieving sufficiently high count rates to measure high frequency events in the cardiac cycle demonstrated. The existing compartmental models used to analyze these data suffer from the limitation of being continuous flow approximations to a truly pulsatile system, and as a result are incapable of simulating the fine structure of the cardiac cycle. In this study, the development of a pulsatile compartmental model is detailed, and the response to a simulated right atrial injection presented. The mass balance equations are developed for a six pool representation, accounting for the pulsatile nature of the flow, and for ventricular volume variation during systole and diastole. The equations are solved by digital computer using techniques of numerical integration. The effects of an atrial septal defect and mitral insufficiency are also studied. Procedures for using the model in conjunction with experimental data for purposes of parameter estimation are suggested. (auth)

8110 (CONF-730627-, pp 53-63) CORRECTION OF ORGAN MOTION BY FILTERING TECHNIQUES. Schmidlin, P. (Deutschen Krebsforschungszentrums, Heidelberg); Palmtag, H.; Clorius, J. 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

The nonperiodic motion of a patient and the periodic organ motion due to the respiration of a patient result in the blurring of details in a scintigram. A flexible solution using filtering by Fourier analysis is presented. This method, applicable to all cases when the organ is completely in the visible field of the camera, utilizes a high-pass filter which eliminates, in the frequency domain, the low breathing frequencies. The inverse transform then produces a scintigram corrected for the breathing motion. (auth)

8111 (CONF-730627-, pp 64-76) CLINICAL AND RESEARCH APPLICATIONS OF A MULTIPROGRAMMED COMPUTER SYSTEM. Alpert, N. M.; Burnham, C. A.; Hoop, B. Jr. (Massachusetts General Hospital, Boston). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

A nuclear medicine imaging system, NUMEDICS, was developed in order to study the problems of on-line data handling under realistic conditions. Advantages of the multiprogramming approach to data handling are discussed. Special emphasis is given to scintigraphic display techniques and examples of functional imaging of regional cerebral blood flow and regional pulmonary perfusion are used to illustrate potential improvements in processing speed and presentation of dynamic function measurements. (auth)

8112 (CONF-730627-, pp 90-99) ROUTINE CLINICAL PROCESSING OF CAROTID AND MAJOR CEREBRAL BLOOD FLOW BY COMPUTER. Colvin, J. T. (St. Joseph Mercy Hospital, Ann Arbor, MI). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

The mini-computer is becoming an important instrument in

analyzing cerebral vascular flow studies in nuclear medicine. A technique is described that involves the use of a gamma camera interfaced with a dedicated mini-computer system. The patient is placed in front of the gamma camera in the anterior position with his head centered on the crystal face. A bolus of 15 mCi's of ^{99m}Tc pertechnetate is injected into an antecubital vein in the arm, using a modified Lane technique. One second frames are recorded on a 35 mm motor driven camera and simultaneously on a magnetic disk in the mini-computer system. Recording starts as the bolus is injected and is terminated when the bolus reaches the cerebral venous phase. The computer is used to flag the carotids, mid-cerebral arteries, and hemispheres. Curves are then generated by the computer for these areas in the study and are displayed. Ratios are generated by taking the area under the arterial phase of each curve and dividing the values into one another. A normal range of values is shown. These values reflect the interrelation of each of these structures to one another. Emphasis in this analysis is placed on simplifying the computer-operator interactions to the point where the nuclear medicine technologist that performs routine studies can also do the analysis of the cerebral blood flow studies on the computer. Problems and disadvantages involved in this approach are stated and discussed. (auth)

8113 (CONF-730627-, pp 100-112) FUNCTIONAL MAPPING OF RENAL TRANSIT OF ^{131}I-IODOHIPPURAN. Gelfand, M. J.; Allen, F. H.; Green, M. V.; Johnston, G. S.; Bailey, J. J. (National Insts. of Health, Bethesda, MD). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

The renal transit of ^{131}I-iodohippuran is studied using functional mapping. Functional mapping is the creation of an image containing a parameter at each image point that characterizes a dynamic process occurring at that point. Separate functional maps are produced for five parameters of renal function. Studies on patients show localized or generalized abnormalities in one or more functional maps. Abnormalities are seen in patients with hypertension, obstructive lesions, and mixed obstructive and infective lesions. Functional mapping appears to be more sensitive than the combination of renography and sequential scanning using ^{131}I-iodohippuran. Using functional mapping, dynamic information is stated in a spatial context that is not possible using other techniques. (auth)

8114 (CONF-730627-, pp 113-122) SMALL COMPUTER ASSISTED ANALYSIS OF CAMERA RENOGRAMS. Esser, P. D.; Bradley-Moore, P. R.; Atkins, H. L.; Robertson, J. S.; Ansari, A. N. (Brookhaven National Lab., Upton, NY). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

A computer program, SCAAR, originally designed for 3 or 4 probe renography and a large computer has been adapted for use with a scintillation camera interfaced to a small dedicated computer. The system combines the advantages of sequential imaging with the convenience of ready access to the computer by the physician. Following the administration of ^{99m}Tc human serum albumin, the patient can be accurately positioned with respect to the field of view of the camera. A static image allows calculation of relative blood background contribution to each kidney. Subsequently, serial imaging is performed, first with ^{131}I-Hippuran and then ^{99m}Tc-DTPA. The resultant time-activity curves derived from such studies are analyzed with the aid of the computer program. Essentially, the renogram curve is separated into an uptake component and a removal component, the former related to the individual kidney's functioning mass, the latter to the patency of the outflow system. In addition, the time of maximum for each curve and isotope removal factors are calculated. The program offers the possibility of deriving quantitative information of individual function of right and left kidneys and comparing different radioisotopes using this quantitation. (auth)

8115 (CONF-730627-, pp 123-132) DUAL CAMERA-DUAL ISOTOPE DATA ACQUISITION SYSTEM FOR NUCLEAR MEDICINE STUDIES. Williams, L. E.; Ponto, R. A.; Goldberg, M. E.; Payne, J. T.; Loken, M. K. (Univ. of Minnesota, Minneapolis). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

A dual camera-dual isotope data acquisition system has been made possible by the addition of a routing function to the standard Nuclear Data Med II computer camera interface unit. Up to four simultaneous images may be acquired in either frame or list mode. The finite magnetic disc write time implies that list mode data acquisition is the more attractive alternative. Studies have begun on cerebral blood flow, lung ventilation and perfusion, and the beating action of bronchial cilia using the two camera system. Optimal software is currently in preparation. (auth)

8116 (CONF-730627-, pp 133-136) THEORETICAL FOUNDATION FOR ESTIMATION OF EFFECTIVE RENAL PLASMA FLOW IN MAN USING EXTERNAL COUNTING. Shames, D. M.; Farmer, R. E. L. 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

Despite the common use of plasma radioactivity concentration data following single injection of orthoiodohippurate-^{131}I (OIH-^{131}I) for measurement of effective renal plasma flow (ERPF), some questions relating to the use of external counting data for estimation of ERPF remain. A formalism was derived whereby calculation of ERPF is accomplished by external counting data and two plasma samples following single injection of OIH-^{131}I. The formalism has been incorporated into a Focal program which can be operated on a small computer. The program accepts the external counting data, radioactivity values for the two plasma samples, the times after injection at which the plasma samples were obtained, the value of the injected dose of OIH-^{131}I and outputs the computed value for ERPF in cc/minute. (auth)

8117 (CONF-730627-, pp 137-144) CONTINUOUS MEASUREMENT OF LEFT VENTRICULAR EJECTION FRACTION. Parker, J. A.; Secker-Walker, R. H.; Hill, R. L.; Potchen, E. J. (Washington Univ., St. Louis). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

Measurement of left ventricular ejection fraction using radionuclides falls into two groups: methods that make use of the first passage of a bolus of the tracer through the heart and methods in which images of end-diastole and end-systole are gated from the electrocardiogram. Gated images are usually integrated over two to three hundred cardiac contractions and represent the mean performance during this time. A potential advantage of this method is that left ventricular ejection fraction could be measured repeatedly over several hours following a single injection of the vascular tracer, enabling the effect of therapy to be observed. The use of a small digital computer interfaced to a scintillation camera enables the calculation of ejection fraction to be made rapidly. Experience in measuring the change in ejection fraction in dogs given a variety of drugs that alter cardiac performance is outlined. (auth)

8118 (CONF-730627-, pp 145-148) REGIONAL VENTRICULAR FUNCTION AND MYOCARDIAL PERFUSION BY NON-INVASIVE TRACER TECHNIQUES: AN AREA OF POTENTIAL IMPORTANCE FOR COMPUTER APPLICATIONS. Strauss, H. W. (Johns Hopkins Medical Institutions, Baltimore). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

A method is described for the determination of ventricular function by gated blood pool scans following the intravenous administration of ^{99m}Tc-labeled albumin. The method was used to detect the location and size of the infarction in acutely ill patients with acute myocardial infarction. A method is also described for the detection of altered regional myocardial perfusion by scanning the heart following exercising patients to the point of angina pectoris and intravenous administration of ionic ^{43}K at that time. The ^{43}K is distributed in the myocardium in proportion to the myocardial blood flow and exercise maximizes the difference between coronary flow to the normal and abnormal regions of the myocardium. (CH)

8119 (CONF-730627-, pp 149-157) ASPECTS OF DIGITAL ANALYSIS OF CARDIAC RADIONUCLIDE FLOW STUDIES. Budinger, T. F. (Univ. of California, Berkeley). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

Some new techniques of manipulating digitized images from the scintillation camera have been applied to radionuclide cardioangiography. The determination of ejected volume and ejection fraction can be facilitated by a technique of imaging the position of the aortic valve. The use of a gamma function or other analytical techniques of extending uptake-washout curves is justified and offers a sound approach to time-activity curve analysis, particu-

larly as a preliminary step to deconvoluting the impulse response or to multiparameter analysis using discussion theory. Relationship of motion analyses and three-dimensional reconstruction techniques to myocardial imaging is clarified. (auth)

8120 (CONF-730627-, pp 158-161) WHY A COMPUTER? Carlson, J. C. (Hackley Hospital, Muskegon, MI). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

The four-year experience in small-computer usage by the nuclear medicine department at a 360-bed community hospital is related. In this clinical setting, the physician's interface with the computer is the technician-produced hard-copy material that he reviews at his convenience. Processing while accessing is not necessary since approximately 100 computer-produced images are photographed each hour, and processing uses only a small proportion of the total time. Charging $11.00 per study, 94% of the total costs are recovered. (auth)

8121 (CONF-730627-, pp 168-172) COMPUTER IN THE PRIVATE PRACTICE OF NUCLEAR MEDICINE. McConnell, R. W. (St. Paul Hospital, Dallas). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

Several requirements, not the least of which is cost recovery, must be considered and met by a hospital considering the purchase of a computer for use in nuclear medicine. Only the fulfilling of laboratory calculations and the greatly improved processing of camera images permitting more accurate interpretation justify the purchase of the small computer for the community hospital. (auth)

8122 (CONF-730627-, pp 162-167) FACTORS INFLUENCING WHETHER OR NOT TO PUT A COMPUTER INTO YOUR LABORATORY. Weber, P. M. (Kaiser-Permanente Medical Center, Oakland, CA). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

An evaluation of the cost effectiveness of the digital computer in the nuclear medicine laboratory is presented. The computer presently provides favorable cost effectiveness only in in vitro studies in large volume. Its application in image enhancement of static images has not proven to be of great value as an effective diagnostic tool. Its use in the quantitative evaluation of dynamic studies is effective; however, less expensive methods provide essentially the same information. Functional or physiologic displays and mathematical modeling by digital computer, now performed primarily at the research level, could become effective and useful procedures in the near future. (auth)

8123 (CONF-730627-, pp 173-182) APPLICATIONS OF A CAMAC STANDARD DATA ACQUISITION SYSTEM TO PROBLEMS IN NUCLEAR MEDICINE. Erickson, J. J.; Parker, J. F.; Patton, J. A.; Price, R. R.; Brill, A. B. 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

The standardized CAMAC interfacing system for computer acquisition and control systems has been used in a nuclear medicine laboratory to acquire data from three types of scintigraphic systems. The implementation of the CAMAC crate controller is described. Also discussed are the methods and systems configurations used for collection of data from a multiple static probe system, a computer driven scanner, and a dual probe scanner not under computer control. The CAMAC system when compared to a dedicated scanner interface is found to entail a higher initial dollar investment but results in a much more versatile and more easily expanded system. The CAMAC standards also allow the duplication of systems by laboratories without the investments in time and money that result from attempts to adapt the specialized interfaces. (auth)

8124 (CONF-730627-, pp 183-189) UNIVERSAL, SOLID-STATE ATTACHMENT FOR THE COMPUTER RECORDING OF RECTILINEAR SCANNING DATA. Barclay, T. R.; Morris, A. C. Jr.; Lucas, J. P. (Oak Ridge Associated Universities, TN). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

An interface was developed, which can be attached to rectilinear scanners of commercial manufacture, and transmits the scanning data to a remote computer. This interface uses the coupling properties of photodarlington relays to completely isolate the scanner circuits from those of the computer. Signals sent to the computer are "element-step," "line-center," "scan direction," and "count pulses." The computer can form the matrix of a patient's scan from this information. The "element-step" encoder is manufactured from a 1-inch-wide tool-steel strip into which a row of 1/8-inch-diameter holes are accurately machined on 1/4-inch spacings. This tape passes through a photodetector head, producing the required element signals in accordance with the sweep motion of the scanner. Such an interface is inexpensive to build and attach to any rectilinear scanner of contemporary design, and it has sufficient line-driving power to service a remote computer up to a 1000-ft distance. (auth)

8125 (CONF-730627-, pp 209-217) DATA-PROCESSING SYSTEM FOR HIGH RESOLUTION GAMMA-CAMERAS AND SCANNERS. Hasman, A.; Groothedde, R. T. (St. Radboud Univ., Nijmegen, Netherlands). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

A data-processing system is described that can be used for high resolution gamma-cameras. A 100 × 100 matrix can be stored directly in the computer (16 K, PDP-8E, DEC) and if necessary on a disk (1.6 million words, RK8E, DEC). A program used for data-processing is described for use by technicians requiring no computer knowledge. (auth)

8126 (CONF-730627-, pp 218-226) LEAST SQUARES REGRESSION ANALYSIS OF SERIAL SCANS IN DISC OPERATING SYSTEM ENVIRONMENT. Smith, R. O.; Boyd, M. S.; Flowers, W. M. Jr.; Lehan, P. H.; Hellems, H. K. (Univ. of Mississippi, Jackson). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

Least squares regression analysis had been applied to serial scans of the myocardium. The computations were done with a Hewlett-Packard Model 2115A computer using perforated paper tape for intermediate data storage. A digital disc was added to the system and the existing programs were rewritten for use with disc operating system (DOS) procedures. A step-by-step example is shown where regression analysis was applied to serial scans. At least a five-fold savings in time resulted from the conversion even though the cathode-ray-tube (CRT) display program is not yet compatible with DOS. (auth)

8127 (CONF-730627-, pp 227-232) HARDWARE INTERPOLATOR FOR DISPLAY RASTER EXPANSION. Burnham, C. A.; Kaufman, D.; Correll, J. E. (Massachusetts General Hospital, Boston). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

A hardware raster expander has been constructed that allows radioisotope scans collected and processed on a 64 × 64 point grid to be displayed on a 128 × 128 point grid with the intensity interpolation being performed external to the computer. This results in a savings of a factor of four in the amount of storage needed for the refreshed display. The display raster is expanded because it improves the image display quality. The average of the intensity values of the near neighbor points is calculated from the 64 × 64 grid and inserted between points to expand the raster. The technique is not limited by the size of the grid and can be used with core or disk refreshed displays. (auth)

8128 (CONF-730627-, pp 233-238) GRAY SCALE DISTORTION OF COMPUTER DISPLAYS IN BRAIN IMAGING. Carlson, J. C. (Hackley Hospital, Muskegon, MI). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

The production of multiple luminance levels on a general purpose oscilloscope using a technique of variable dot redisplay frequencies is convenient for photographic recording of computer produced images. The display described permits the use of any number of gray steps desired and permits the contrast between steps to be rapidly changed according to the wishes of the operator or according to program instruction. Distorted gray scales are used in an attempt to enhance the perception of minor variations that may

occur in a brain image due to a lesion in the cerebral hemispheres. (auth)

8129 (CONF-730627-, pp 239-243) IMTRAN, AN IMAGE MANIPULATIVE EXTENSION TO FORTRAN. Wilson, S. D.; Erickson, J. J.; Brill, A. B. 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

This paper describes an image manipulative extension to FORTRAN and discusses a preliminary implementation. IMTRAN (IMage TRANslator) allows the creation of an "IMAGE" variable by means of an IMAGE declaration statement similar in form to the standard FORTRAN declaration statements such as INTEGER, REAL, etc. I/O operations for the image variable are described as well as arithmetic operations. The preliminary implementation is in the form of sifter which produces standard FORTRAN code in one of nine dialects. Hopefully the use of such image manipulation capabilities as those provided by IMTRAN will result in reduced coding time for experimental algorithms as well as routine programs which are less machine specific and therefore more amenable to inter-laboratory code sharing. (auth)

8130 (CONF-730627-, pp 244-249) SIMULATION AND MODELING OF HEART BOLUS ANGER CAMERA STUDIES. Baglan, R. J.; Brill, A. B.; Price, R. R. (Vanderbilt Univ., Nashville). 1973.

From 3rd symposium on sharing of computer programs and technology in nuclear medicine; Miami, Florida, USA (16 Jun 1973).

In proceedings of third symposium on sharing of computer programs and technology in nuclear medicine.

Much effort has been expended in developing radioisotopic techniques for use in obtaining parameters characterizing cardiac function. In these studies a bolus of radioactive material is injected intravenously and the time-rate-of-flow of the isotope through the cardiac region is monitored. Attempts are described to fit a mathematical simulation model to a set of isotope dilution curves obtained from patient studies. By using such a model it is hoped that blood flow parameters can be obtained. (auth)

8131 (COO-119-248, pp 336-337) MEASUREMENT OF PLASMA CORTICOSTERONE (CPD.B) LEVELS IN MAN BY RADIOIMMUNOASSAY. Nabors, C. J. Jr.; Mahajan, D. K.; West, C. D. 31 Mar 1973.

In research in radiobiology.

A method that utilizes radioimmunoassay for measuring plasma cpd B levels in man is described. Antisera were obtained by immunizing rabbits with cpd B-21-succinyl-BSA. The antiserum was highly specific for cpd B with only the following steroids having cross-reactions greater than 1%: cortisol (3%), testosterone (10%), and progesterone (44%). It is suggested that measurements by this method may be clinically useful especially in adrenal suppression and stimulation tests. (HLW)

8132 (COO-119-248, pp 338-352) SIMULTANEOUS MEASUREMENT OF MULTIPLE PLASMA STEROIDS BY RADIOIMMUNOASSAY DEMONSTRATING EPISODIC SECRETION. West, C. D.; Mahajan, D. K.; Chavre, V. J.; Nabors, C. J.; Tyler, F. H. 31 Mar 1973.

In research in radiobiology.

A method for measuring cortisol, corticosterone, testosterone, progesterone, and 17-OH progesterone simultaneously in 2 ml of plasma has been developed especially for episodic secretion studies in which many frequent assays are required. Steroids were extracted from plasma, separated into four fractions by paper chromatography, and individual steroids in each fraction were measured by radioimmunoassay. The individual steroid radioimmunoassays were demonstrated to be sensitive, specific, accurate, and precise. (auth)

8133 (COO-119-248, 353-369) RADIOIMMUNOASSAY OF HUMAN PLASMA CORTICOSTERONE: METHOD, MEASUREMENT OF EPISODIC SECRETION AND ADRENAL SUPPRESSION AND STIMULATION. Nabors, C. J. Jr.; West, C. D.; Mahajan, D. K.; Tyler, F. H. 31 Mar 1973.

In research in radiobiology.

Although corticosterone is essential for life in rats and certain other animals, it is not absolutely required by man. Whether it plays an important role in normal physiological processes or disease in man has not been established. A reliable radioimmunoassay for plasma corticosterone was developed. This method requires only small samples and could be of value in clinical studies on corticosterone. The assay has been applied to studies in normal subjects on 8 a.m. levels, diurnal variations, ACTH stimulation and dexamethasone suppression. Corticosterone production has been shown to be both episodic and ACTH dependent. (auth)

8134 (LIB/TRANS-511) PULMONARY SCINTIGRAPHY WITH RADIOACTIVE $HgCl_2$ GLUTATHIONE FOR LUNG CANCER INVESTIGATIONS. Hirata, M.; Tochiko, H.; Hiroshi, T.; Marukata, B. Translated from Nippon Kyobu Rinsho; 31: No. 2, (1972). 18p. Dep. NTIS (U. S. Sales Only) $3.00.

A total of 180 cases suspected of pulmonary malignant tumour were scanned with $HgCl_2$-gluthathione labeled with ^{197}Hg or ^{203}Hg. The method was found to be extremely useful as the screening test for investigation of lung cancer. Hyperfixation of mercury was observed in the cases of malignant tumour and certain active inflammatory diseases, such as tuberculosis, although the hyperfixation by malignant lesion was more dense than the other lesion. The fixation-ratio, that is the ratio between the amount of radioactivity found over the diseased parts compared the amount at symmetrical site, is important to detect the small tumour. Mercuric chloride of high specific activity is favourable to reveal malignant lesion and avoid the harm of mercury. (auth)

8135 (LURI-1972-2) INVESTIGATION OF WYLO-10-KIT FOR PREPARATION OF ^{99m}Tc-LABELLED PARTICLES FOR SCINTIGRAPHY OF THE LUNGS. Persson, B.; Strand, S. E. (Lund Univ. (Sweden). Radiofysiska Institutionen). Mar 1972. 7p. (In Swedish). Dep. NTIS (U. S. Sales Only) $3.00.

The preparation of ^{99m}Tc-labeled albumin is described. Examination of the labeled albumin was done in vitro as well as in vivo. Rabbits were used for the in vivo examination. The distribution of activity in the lungs, liver, kidneys, and bladder was examined at different time intervals after the injection. (SW)

8136 IN VITRO APPLICATION OF RADIOISOTOPES. Yamada, H. (Tokyo Metropolitan Geriatric Medical Center). Genshiryoku Kogyo; 19: No. 7, 36-39(Jul 1973). (In Japanese).

The present status of exploitation of RIA (radioimmunoassay), CPBA (competitive protein binding assay), and RSA (reserve saturation analysis) were outlined as the in vitro test method for measuring vitamins, hormones, enzymes, and pharmaceuticals present in vivo in small amounts by the use of radioisotopes. For each method, measured substances, bound substances, the method of isolation, and labeled substances were tabulated. RIA is said to be capable of labeling as small an amount as 10^{-15} mol. and disposing of a large number of samples simultaneously. CPBA is a method which utilizes the binding reaction of the substance to be measured with specific binding protein and is used at present for thyroxine, vitamin B_{12}, estrogen, and cortisol. RSA is used for measuring binding capacity of unsaturated iron, total iron, and triiodothyroxine with non-protein hormone, iron, and copper. (JA)

8137 RADIOIMMUNOASSAY OF OVINE AND BOVINE GROWTH HORMONES: TECHNIQUES AND APPLICATIONS. Martal, J. (CNRZ, Jouy-en-Josas, France). Compt. Rend., Ser. D; 277: No. 2, 221-224(9 Jul 1973). (In French).

A method was developed for radioimmunoassays of the STH of ruminants using imperfectly purified hormones with elimination of the radioiodated prolactinic contaminant of the radioactive STH and neutralization of the antiprolactine antibody; the description of the assay technique and its application to the determination of the plasma STH levels of different ruminant species are discussed. (FR)

8138 RECENT GAMMA CARDIOGRAPHY TECHNIQUE. Morin, P. P.; Lahellec, M.; Morin, J. F.; Caroff, J.; Savina, A. (Hopital A. Morvan, Brest, France). J. Biol. Med. Nucl.; 8: No. 31, 15-20(1973). (In French).

Heart ventricle volumes can easily be determined from an external biventricle curve obtained from simple cardiac output measurements made using ^{99m}Tc-labeled red blood corpuscles. The studies made are based on a method recently described by Ishii and MacIntyre. Preliminary results agree well with data found in the literature. (FR)

8139 DETERMINATION OF THE LATENT FIXING CAPACITY OF IRON BY UIBC SERUM USING AN ISOTOPIC METHOD. Nyssen, M.; Bizollon, C. A.; Dorche, J. (Hopital de la Croix Rousse, Lyon). Ann. Biol. Clin. (Paris); 31: No. 4, 275-282(1973). (In French).

Three isotopic methods for determining the latent fixing capacity of iron by serum (UIBC) are compared with a chemical method. Satisfactory results were obtained only with a method involving measurement of the radioactivity fixed on centrifuged washed resin. The quality of the technique is considered from the point of view of precision. The problem of various adsorbents is considered. (FR)

8140 USEFULNESS OF ^{99m}Tc–Sb FOR RENAL SCINTISCANNING. Morcellet, J. L.; Baret, A.; Ramon, V.; Le Mignant, A. (Hopital d'Instruction des Armees Sainte-Anne, Toulon-Naval, France). pp 372-377 of Fourteenth Colloquium on Nuclear Medi-

cine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French)

From fourteenth colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

The complex, Sb ^{99m}Tc in colloidal sulfur is an excellent agent for scintigraphy of the liver and the pancreas; it was possible to detect the impurity with a reproducibility of 90%. The impurity is particularly stable, a property distinguishing this complex from those already used (^{99m}Tc-DTPA and ^{99m}Tc-Fe-ascorbate). The new complex has a similar biological behavior to the former complexes with a higher uptake by the kidneys and a smaller uptake by the liver. (FR)

8141 LUNG FUNCTION TESTS IN MUCOVISCIDOSIS PATIENTS USING A NEW TECHNIQUE, THE COMPTON RECOIL SCATTER. Stephan, U.; Schuster, W. (Univ., Erlangen, Ger.). Deut. Gesundheitsw.; 27: 2227-2230(Nov 1972). (In German).

Since 1968 we have been applying a new method, the Compton re-scattering, which has not yet been applied in medical diagnostics, for testing the pulmonary function. The lung is penetrated by a sharply bundled ray of energy-rich quanta. From the volume penetrated by the rays there emerge scattered quanta. Their number is directly proportional to the electronic density in the volume penetrated by radiation. The scattered quanta are collected by a collimator. Their number is determined by a scintillation counter. On this basis the absolute value of the density of the lung volume examined is determined, being expressed in gramm ml. In this way the density and density changes during respiration can be exactly determined. As a source of radiation we used cesium-137. (auth)

8142 RADIOISOTOPIC MICROASSAY FOR LYMPHOTOXIN USING TECHNETIUM-99 LABELED CELLS. Barth, R. F.; Gillespie, G. Y.; Rosenau, W. (Univ. of Kansas, Kansas City). Proc. Soc. Exp. Biol. Med.; 144: No. 2, 564-568(Nov 1973).

A new microassay for lymphotoxin was developed utilizing murine L-929 target cells prelabeled with technetium-99m, a high specific activity, metastable gamma emitter, which is bound to living cells and not released in appreciable quantities by dead or injured cells. Target L-cells prelabeled with ^{99m}Tc were added to micro tissue culture plates at a concentration of 10,000 cells/well. Eighteen hr later lymphotoxin or control material was added and the cells were incubated for an additional 12 to 28 hr. A maximum cytocidal effect was observed after incubation of target cells for 28 hr with 100 CU of lymphotoxin. The number of surviving adherent cells as determined by gamma counting for ^{99m}Tc was in accord with that recorded by visual enumeration. The ^{99m}Tc microassay is a sensitive, easily performed, rapid test for lymphotoxin activity that appears to have a number of advantages over previously reported in vitro methods. (auth)

8143 CISTERNOGRAPHY: FROM EARLY TRIBULATIONS TO A USEFUL DIAGNOSTIC PROCEDURE. Di Chiro, G. (National Institutes of Health, Bethesda, MD). Johns Hopkins Med. J.; 133: 1-15(Jul 1973).

The history of cisternography and its application as a diagnostic procedure are reviewed. The radiopharmaceuticals used in cerebrospinal fluid scanning are discussed. (ERB)

8144 RENAL SCANNING COMPOSITION AND METHOD USING TECHNETIUM-99m. Halpern, S. E.; Tubis, M.; Endow, J. S. (to Veterans Administration). US Patent 3,749,913. 31 Jul 1973. Filed date 24 Jun 1971. 4p.

The present invention relates to an improved renal scanning agent of the scintillating type using a radioisotope. The present composition embodies a kidney scanning agent with technetium-99m as the active scintillating agent complexed or chelated with penicillamine and also containing as a carrier acetazolamide (DIAMOX). The function of the penicillamine is to keep the technetium-99m in a reduced state and to exclude the Tc(+7) pertechnetate variety. (auth)

8145 INVESTIGATION OF METHODS FOR MEASUREMENT OF RADIOACTIVITY IN TRITIATED DNA AND APPLICATIONS TO ASSAYS FOR DNA POLYMERASE ACTIVITY. Schrier, B. K.; Wilson, S. H. (National Inst. of Health, Bethesda, MD). Anal. Biochem.; 56: No. 1, 196-207(Nov 1973).

Methods for collection and counting of ^{3}H-labeled DNA on nitrocellulose and glass fiber filters were investigated. The findings are of potential importance in determining the amount of radioactivity in DNA as well as other macromolecules. The highest counting efficiencies were observed using glass fiber filters, NCS for dissolving DNA, and a toluene scintillation mixture for counting. However, glass fiber filters, even with large amounts of coprecipitant albumin, failed to collect all of low molecular weight (approx 185,000 daltons) DNA. Thus, in many applications nitrocellulose filters proved to be more advantageous. (auth)

8146 PREPARATION OF PURE [^{3}H] ANISOMYCIN BY TRITIUM EXCHANGE LABELING. Barbacid, M.; Vazquez, D. (Inst. of Cellular Biology, Madrid). Anal. Biochem.; 56: No. 1, 16-25(Nov 1973).

The antibiotic anisomycin is a very useful tool in studying protein synthesis since it is a specific inhibitor of the peptidyl transferase centre of eukaryotic ribosomes. By tritium exchange labeling followed by chromatographic and electrophoretic purification, [^{3}H] anisomycin of specific activity 285 mCi/mmole was obtained and the methodology followed is described in this paper. This method is useful in preparing tritium labeled antibiotics other than anisomycin provided that the nonradioactive compound has the following characteristics: a chemical structure resistant to the method required for tritium labeling; ionic groups; and chromophore groups with absorption maxima in the uv or visible part of the spectrum. Since these circumstances concur frequently in a number of chemical structures, a method essentially similar to that described in this work might be widely used. The method was not applicable to amicetin, blasticidin S, and fusidic acid, as these antibiotics were broken down during the tritium labeling. However, gougerotin, a well known inhibitor of peptide bond formation by prokaryotic and eukaryotic ribosomes has been tritiated and purified following a method very similar to that described in this contribution to [^{3}H] gougerotin (110 mCi/mmole) (auth)

8147 QUANTITATION OF MOUSE MAMMARY TUMOR VIRUS (MTV) VIRIONS BY RADIOIMMUNOASSAY. Cardiff, R. D. (Univ. of California, Davis). J. Immunol.; 111: No. 6, 1722-1729(Dec 1973).

A quantitative radioimmune assay for the mouse mammary tumor virus (MTV) was developed. The assay used highly purified MTV virions that were enzymatically externally labeled with ^{125}I. The radioimmune precipitation (RIP) of ^{125}I-MTV with anti-MTV was specifically inhibited with unlabeled MTV. The degree of inhibition of RIP was directly related to the quantity of unlabeled MTV added. The assay reproducibly detected as little as 5 ng of intact virus. The RIP of ^{125}I-MTV with anti-MTV was not inhibited by murine mammary cell extracts, milk, or C-type virus particles. Important variables in this system are discussed. (auth)

8148 EVALUATION OF CELL-MEDIATED CYTOTOXIC REACTIVITY AGAINST TUMOR ASSOCIATED ANTIGENS WITH ^{125}I-IODODEOXYURIDINE LABELED TARGET CELLS. Oldham, R. K.; Herberman, R. B. (National Cancer Inst., Bethesda, MD). J. Immunol.; 111: No. 6, 1862-1871(Dec 1973).

An in vitro lymphocyte cytotoxicity tissue culture assay utilizing ^{125}I-iododeoxyuridine (^{125}IUdR) labeled target cells is described. Because of the labeling characteristics of ^{125}IUdR this isotope appears to offer advantages over previously used labels. Toxicity of the isotope is a factor to be evaluated with each cell line. The method of calculation of cytotoxicity lends some insight into the spontaneous cell death rate of tissue culture systems as used for cytotoxicity. This assay is of value in detecting tumor-associated antigens in both animal and human tumor systems. (auth)

8149 RADIOIMMUNOASSAY OF CALCITONIN IN SHEEP FETUSES. Garel, J. M.; Savajol, H.; Barlet, J. P. (Univ., Paris). Compt. Rend., Ser. D; 277: No. 2, 217-220(9 Jul 1973). (In French).

A radioimmunoassay method for ovine calcitonin is described; the method is based on the existence of a crossed reaction between the ovine calcitonin and a porcine anticalcitonin serum. The perfusion of calcium in gestating goats increases their calcemia and increases their plasma calcitonin concentration. In the case of fetuses, neither the calcemia nor the calcitoninemia are modified. The perfusion of calcium chloride in the fetus very rapidly increases the rate at which the hormone is secreted. (FR)

8150 RADIOIMMUNOSORBENT ASSAY OF FOLLICLE-STIMULATING HORMONE IN SERUM AND URINE FROM MEN AND WOMEN. Wide, L.; Nillius, S. J.; Gemzell, C.; Roos, P. Acta Endocrinol., Suppl.; No. 174, 5-58(1973).

A radioimmunosorbent technique was used for the assay of the pituitary gonadotropins. Human follicle-stimulating hormone (FSH) and luteinizing hormone (LH) preparations of the highest purity and labeled with ^{125}I were used as reference standards. The antisera were raised against more purified gonadotropin preparations than generally used as immunogens. The immunosorbent preparations with antibodies directly or indirectly coupled to insoluble polysaccharides were tested for their capacity to bind labeled antigen during 24 hrs in a total reagent volume of 0.7 ml. The amount that bound about 15% was determined and used in the assays. The use of solid phase-coupled antibodies simplifies the separation of antibody-bound and free antigen. The

separation can be made highly effective with an almost complete removal of unbound antigen. It is possible to obtain a rapid answer within 24 hrs without sacrificing high sensitivity and precision. The method is well suited for large scale analyses of protein hormones in the clinical routine. Physiological studies on episodic changes of FSH and LH in serum in the daytime, on FSH and LH in serum and urine during the menstrual cycle, and on serum levels and urinary excretion of FSH and LH were performed. (DE)

8151 BIOASSAY OF CALCITONIN BY DETERMINATIONS OF BLOOD CALCIUM-45 LEVELS IN RATS AND MICE. Melander, A. (Univ. of Lund, Sweden). Acta Endocrinol.; 73: 69-79(1973).

The possibility of measuring calcitonin by determinations of blood ^{45}Ca in young rats and mice was investigated. Blood samples were taken by orbital puncture on conscious animals. In both species, blood ^{45}Ca levels fell rapidly during the first 24 h after one subcutaneous injection of $^{45}CaCl_2$. Thereafter, the elimination rate was slow, indicating that an equilibrium state was reached. During this period, single iv injections of highly purified porcine calcitonin induced log-dose-dependent blood ^{45}Ca reductions in both rats and mice. Maximal responses were recorded at 30 min after injection, and the log-dose-response regressions were linear between 0.1 and 5.0 mU in young rats, and between 2.0 and 80.0 mU in young mice. The mean indices of precision were 0.18 and 0.27, respectively. Blood ^{45}Ca reductions were also recorded on injection of extracts from rat thyroids, cat thyroids, and chicken ultimobranchial glands, as well as an injection of plasma from patients with thyroid medullary carcinoma. No reduction in blood ^{45}Ca was obtained by injections of ACTH, TSH, cortisone, thyroxine, or insulin. The responses to calcitonin were augmented if the animals had had a low calcium intake before the experiment, and/or if the animals were injected with 0.075 M NaH_2PO_4 immediately before injection of the hormone. Rats were more sensitive than mice to porcine calcitonin and to rat and cat thyroid extracts, while the opposite was true with chicken ultimobranchial extracts. No inter-species difference was recorded with human calcitonin. The assay appears to be useful for both clinical and experimental purposes. (auth)

8152 RADIOIODINE DOSIMETRY AND THE USE OF RADIOIODINES OTHER THAN ^{131}I IN THYROID DIAGNOSIS. Wellman, H. N.; Anger, R. T. Jr. (Univ. of Cincinnati). pp 13-30 of Thyroid Radionuclide Uptake Measurements. Vienna; International Atomic Energy Agency (1973).

From conference on thyroid radionuclide uptake measurements; Vienna, Austria (17 May 1971).

Of the 24 radioisotopes of iodine, only four, ^{123}I, ^{125}I, ^{131}I, and ^{132}I have been utilized clinically to any significant extent. Optimal use of radioiodine involves the consideration of a particular isotope's physical properties in relation to the economics and logistics of shipment, the quality of generated clinical studies, and radiation dosimetry. In this paper, ^{123}I, ^{125}I, and ^{132}I are critically evaluated with reference to each of these considerations. In terms of absorbed dose to the thyroid, ^{123}I and ^{132}I are the isotopes of choice, giving doses about $^{1}/_{10}$ and $^{1}/_{100}$ of the dose from ^{125}I and ^{131}I respectively. Because of its abundant high energy photons, ^{132}I is impractical for thyroid imaging procedures. Its very short half-life and availability in a generator system, however, give advantages of low radiation dose and applicability in serial thyroid function studies. The relatively long half-life (60 days) and ready availability of ^{125}I are economical advantages. Equivocal clinical results and an only slightly lower radiation dose than ^{131}I, however, are significant disadvantages. The isotope ^{123}I, in addition to giving a low radiation dose, theoretically provides the best combination of physical properties for clinical utilization. Until now, however, the economics of ^{123}I production and contamination with the higher energy isotope, ^{124}I, have limited its utilization. Despite the ^{124}I contamination, high resolution images have been obtained, particularly with a gamma camera and pinhole collimator, and newer methods of production hold promise of large amounts of high purity ^{123}I. (auth)

8153 THYROID ^{131}I UPTAKE MEASUREMENT WITH A SCINTILLATION CAMERA. Kakehi, H.; Ssequsa, K. (Chiba Univ., Japan). pp 157-164 of Thyroid Radionuclide Uptake Measurements. Vienna; International Atomic Energy Agency (1973).

From conference on thyroid radionuclide uptake measurements; Vienna, Austria (17 May 1971).

This paper describes experimental and clinical studies aimed at the development of a method using a gamma camera with a pin-hole collimator for measuring the late uptake of ^{131}I by the thyroid. Attempts to measure uptake under the condition used for thyroid scintigraphy, namely with the surface of the collimator at a working distance of 2 to 5 cm from the surface of the neck gave values significantly lower than those obtained by the ORINS standard method, the difference between the two values reaching 38%. At a working distance of 20 to 25 cm, scintigraphy was no longer practicable and the statistical errors in the measured uptakes were larger because of the reduced counting rates, but the values obtained were in general agreement with those obtained by the ORINS standard method. (auth)

8154 PERFORMANCE OF THE IAEA STANDARD COLLIMATOR FOR THYROID RADIOIODINE UPTAKE MEASUREMENTS WITH RADIONUCLIDES OTHER THAN ^{131}I. Daou, R. G. (International Atomic Energy Agency, Vienna). pp 121-134 of Thyroid Radionuclide Uptake Measurements. Vienna; International Atomic Energy Agency (1973).

From conference on thyroid radionuclide uptake measurements; Vienna, Austria (17 May 1971).

The paper describes studies of the performance of a standard collimator developed by the International Atomic Energy Agency for thyroid ^{131}I uptake tests with other radionuclides used for thyroid uptake tests, in particular ^{125}I, ^{99m}Tc, ^{123}I, and ^{132}I. With the first three of these radionuclides, both the sharpness of the cutoff and the effectiveness of the side shielding were better than with ^{131}I, in accordance with predictions based on the energy of their photon radiation. With ^{132}I, however, which emits γ rays of up to 1.39 MeV in energy, performance was found to be grossly inadequate both as regards cutoff and side shielding, and a considerable increase in the thickness of the lead alloy would be necessary to achieve a satisfactory performance. (auth)

8155 MEASUREMENT OF THYROID UPTAKE USING ^{99m}Tc. Goolden, A. W. G.; Glass, H. I.; Williams, E. D. (Hammersmith Hospital, London). pp 41-62 of Thyroid Radionuclide Uptake Measurements. Vienna; International Atomic Energy Agency (1973).

From conference on thyroid radionuclide uptake measurements; Vienna, Austria (17 May 1971).

This paper surveys the clinical value of early thyroid uptake tests with ^{99m}Tc are surveyed, methods of carrying out such tests are described, and preliminary clinical results obtained using these methods are presented. Since ^{99m}Tc in the form of pertechnetate is trapped by the thyroid in the same manner as iodide, but does not become organically bound, the early uptake of ^{99m}Tc is an index of the iodide-trapping function of the thyroid independent of its iodine-binding function. The 20-min ^{99m}Tc uptake test is a simple and reliable test of thyroid function, and since it can be carried out repeatedly it is particularly valuable in following the progress of patients undergoing therapy with antithyroid drugs. One method of carrying out the test using a dual-detector scanner for the measurement of uptake and another using a single-detector scanner are described and their relative merits discussed. Preliminary clinical results obtained by these methods, including the results of suppression tests carried out with ^{99m}Tc and the results of long-term follow-up studies on patients treated with antithyroid drugs, are presented. (auth)

8156 QUANTITATIVE SCINTIGRAPHY IN THE STUDY OF EARLY THYROID UPTAKE. Bok, B. (Institut Gustave Roussy, Villejuif, France). pp 91-119 of Thyroid Radionuclide Uptake Measurements. Vienna; International Atomic Energy Agency (1973).

From conference on thyroid radionuclide uptake measurements; Vienna, Austria (17 May 1971).

The general problems inherent in early thyroid radionuclide uptake measurements are reviewed with particular reference to clinical requirements, choice of radionuclide, choice of measuring device, and processing of the data obtained. The author's personal experiences in carrying out measurements of ^{99m}Tc uptake by means of a technique involving off-line computer analysis of digital data from a single-detector scanner recorded on magnetic tape are described. The computer program used allows correction of the data for radioactive decay, subtraction of background, smoothing, computation of the total number of counts recorded within a given contour of constant percentage counting rate, and computation of the area enclosed within such a contour. The results of detailed physical studies aimed at establishing the technique used on a firm basis are given in detail, particular attention being given to the problems arising from variations in the depth of the thyroid and in the level of extrathyroidal radioactivity. Illustrative results obtained in a single hyperthyroid patient are also presented and the clinical value of the technique discussed. (auth)

8157 MEASUREMENT OF CARDIAC OUTPUT WITH AND ORGAN TRAPPING OF RADIOACTIVE MICROSPHERES. Archie, J. P. Jr.; Fixler, D. E.; Ullyot, D. J.; Hoffman, J. I. E.; Utley, J. R.; Carlson, E. L. (Univ. of California, San Francisco). J. Appl. Physiol.; 35: No. 1, 148-154(Jul 1973).

Cardiac output in dogs and lambs was measured with radioactive microspheres. The radioactivity injected (I_i) into left atrium and in an arterial reference sample (I_{ar}) drawn at constant rate (Q_{ar}) during injection was counted; cardiac output (CO) = $Q_{ar}(I_i/I_{ar})$. On

comparison with known flows this method was accurate and precise ($r = 0.94$, $s_{y,x} = 0.11$ liter/min). Comparing nonsimultaneous indocyanine green and microsphere cardiac outputs gave more variability ($r = 0.90$, $s_{y,x} = 0.41$ liter/min). A method is also presented of determining organ extraction of microspheres after left atrial injection from reference samples from any artery and a representative vein draining the organ being studied. The percentages of radioactivity of microspheres 4–12-μ-diameter not trapped by heart, kidney, and systemic circulation of lambs were 3.6 ± 2.9%, 2.8 ± 1.9%, and 5.5 ± 2.2% (mean and standard deviation). Under 0.1% of the radioactivity of 15-μ-diameter spheres and 4–26% of the radioactivity of 4–12-μ-diameter spheres were not trapped by dog kidneys. These results are based on radioactivity measurements and do not account for variations in sizes of trapped and nontrapped spheres. Diameters of nontrapped spheres compared to injected spheres suggest that nontrapping in the lamb was due to spheres under 7 μ diameter. (auth)

8158 SOME DEVELOPMENTS IN THE USE OF RADIOPHOSPHORUS. Bullen, M. A.; Godden, T. J.; Hale, B. T.; Preece, A. W. (United Bristol Hospitals, London). pp 59-76 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

The uptake of ^{32}P is a useful diagnostic technique for confirming the presence of eye neoplasms and for investigating the hormonal status of breast neoplasms and their response to therapy. Continuous measurements of radioactivity are of value for the evaluation of neoplasm response to radiosensitizers and radiotherapy and the efficiency of semiconductor detectors with various data recording systems is discussed. (CH)

8159 NUCLEAR MEDICINE. Detection of Occult Metastases and Diagnostic Role in Management of Patients With Cancer. James, A. E. (Johns Hopkins Medical Institutions, Baltimore); Wagner, H. N. pp 188-219 of Modern Trends in Radiotherapy. 2. Deeley, T. J. (ed.). New York; Appleton-Century-Crofts (1972).

Applications of radionuclide scanning in the diagnosis of neoplasms and the evaluation of the response of patients to therapy are reviewed. It is pointed out that recent improvements in imaging devices and radiopharmaceuticals have increased the yield of information from scintiscans. Emphasis is placed on the value of scintiscanning for the localization of metastases from primary tumors. (CH)

8160 TOMOGRAPHIC IMAGING IN NUCLEAR MEDICINE. Proceedings of a Symposium, New York, New York, September 15–16, 1972. Freedman, G. S. (ed.). New York; Society of Nuclear Medicine, Inc. (1973). 289p. (CONF-720959-). $12.00.

From symposium on radionuclide tomography; New York, New York, USA (15 Sep 1972).

Nineteen papers are devoted to a discussion of tomographic systems under the following general headings: moving detector tomographic systems; camera-type tomographic systems; coincidence tomographic systems; and other related methods. Seven papers are devoted to a discussion of clinical experiences and results using various tomographic systems. (ERB)

8161 XENON-133 SYSTEM FOR LOW-COST, LOW-DOSE PATIENT STUDIES. Nuclear Medicine Technical Note. DHEW Publication No. (FDA) 72-8028. Cincinnati; Bureau of Radiological Health (Mar 1972). 4p.

Several commercially-available systems for supplying ^{133}Xe in saline are in use but do not provide as great a concentration as is desirable for clinical purposes. These systems are also relatively expensive. In order to have a continuously available supply of sterile, pyrogen-free ^{133}Xe saline solution at low cost, a system was designed based on the concept of dynamic equilibrium between a trapped bubble of ^{133}Xe gas and a small volume of periodically renewed saline. Unidirectional flow of fresh saline and a unique ampule design contribute to an extremely low xenon loss rate. High concentrations of xenon are readily available. The system consists of a borosilicate glass ampule, a tap unit, a shield, and a supply syringe containing fresh, sterile saline. (auth)

8162 IMPROVEMENT OF SPECIFITY IN RADIOIMMUNOASSAYS. Phillips, A. P. (Home Office Central Research Establishment, Aldermaston, Eng.). Clin. Chim. Acta; 44: No. 3, 333-340(30 Mar 1973).

The specificity of a radioimmunoassay for serum digoxin was investigated. The assay used ^{3}H–digoxin and rabbit antiserum to a digoxin-albumin conjugate, with separation of antibody-bound and free tracer by adsorption of the latter on charcoal. By exploiting the kinetics of dissociation of the steroid antibody complex, digoxin could be distinguished from the other steroids. Comparison of apparent digoxin levels, measured in the two types of assay, based respectively on the principles of simultaneous addition and preincubation, imposes a stringent specificity test in the assay of serum samples. The double assay principle is suggested for consideration in all radioimmunoassays utilizing incompletely specific antisera. (INIS)

8163 EXPLORATION OF THE PULMONARY FUNCTION USING XENON 133. Radermecker, R. (Institut Provincial E. Malvoz, Liege); Bartsch, P.; Petit, J. M. pp 378-383 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French)

From fourteenth colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

Studies of pulmonary region perfusion and ventilation were performed using gaseous xenon-133 for ventilation studies and the liquid form for irrigation studies. The examination involved the inhaling by the patient of a 0.1mCi/l xenon-133 concentration; the patient receives an intravenous injection of 150 μCi. The absorbed doses are as follows: 57.3 to 99.7 mrads for the tracheal mucous tissue; 9.7 to 18.02 mrad for the lungs; 0.58 to 1.13 mrad for the gonads. The mathematical analysis of the curves obtained is effected using an electronic computer of the DIEHL bureau or an IBM 1130 computer. (FR)

8164 RESULTS OF EXPLORATIONS OF THE PULMONARY FUNCTION USING XENON-133. Bartsch, P. (Institut Provincial E. Malvoz, Liege); Radermecker, R.; Petit, J. M. pp 384-390 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French)

From fourteenth colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

The pulmonary function was explored in the case of various affections using xenon-133: pneumoconiosis, vesicular emphysema, neoplasia, and the McLeod syndrome. The scintiscanning method and the radiospirometric method give different results from which general conclusions are difficult to obtain. Nevertheless it appears that information obtained by radio-spirometry is more exact when considering the functional value of one lung in relation to the other. In addition, this method possesses a sensitivity threshold, which is lower than that of the scintiscanning method. (FR)

8165 GAMMA-SCINTISCANNING OF THE ORBIT USING ^{99m}Tc (TcO_4 AND A FERROUS Tc-ASCORBATE COMPLEX). Boudet, C.; Bastons, G.; Arnaud. (Centre Guide Chaulia, Montpellier, France). pp 392-395 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French).

From 14th colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

Gammagraphy provides a simple, rapid, and innocuous method for routine explorations of the pathology of the orbit. The essential information is represented by exophthalmia. A further scintiscanning examination can then be used to reveal intraorbital vascular or tumoral processes. (FR)

8166 RADIOIMMUNOASSAY OF IMMUNOGLOBULIN E. Preliminary Results. Halpern, G.; Levy, C. (Univ., Paris). pp 414-415 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French).

From 14th colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1973).

Normally E(IgE) immunoglobulins are present at very low levels in the serum. A radioimmunoassay technique is used to measure these levels. This technique involves antibodies bound to a solid phase (Sephadex); ^{125}I labelled IgE; centrifugal separation. Under particular circumstances the IgE level increases, e.g., children under 15 years of age with allergies. (FR)

8167 DETECTION OF AUSTRALIA ANTIGEN USING THE RADIOIMMUNOASSAY METHOD. Application to Blood Derivatives Used As Biological Tracers. Amouch, P.; Drouet, J. (Centre National de Transfusion Sanguine, Paris). pp 440-442 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French).

From 14th colloquim on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

The detection method consists of allowing a specific antibody and purified ^{125}I labeled Australia antigen to react with antigen present in the sample analyzed. After incubation and separation of the antigen-antibody complexes of the antigen remaining free, the radioactivity of the free and bound fractions is measured. A comparative study with an electron microscope method of detection carried out on the serums of 81 sick patients demonstrated a consistency of about 90%. (FR)

8168 USE OF ^{99m}Tc LABELED SODIUM PYROPHOSPHATE IN SCINTISCANNING OF THE SKELETON. Perez, R. (Ameri-

can Hospital, Paris); Panneciere, C.; Cohen, Y.; Henry, R. pp 444-447 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French).

From 14th colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

Experimental and clinical studies of this compound demonstrate that it meets the requirements for routine human pathology measurements. This radioactive complex must be made at the time it is required and sterilized by passage across a 0.22-μm pore filter. The control methods studied involve chromatography, osmolarity, toxicology, and scintiscanning with animals. The images obtained indicated a promising future for this product in locating bone metastases and in studies of the therapeutic effects on some lesions of the skeleton. (FR)

8169 STATISTICAL STUDY OF THE RESULTS OF T_3-T_4 TESTS. Besnard, J. C.; de Rycke, G.; Floyrac, G.; Planiol, T. (Centre Hospitalier Regional Bretonneau, Tours, France). pp 83-89 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French)

From fourteenth colloquium on nuclear medicine. Vol. 3; 9 Jun 1972 (9 Jun 1972).

Statistical studies of T_3-T_4 tests carried out on 1100 cases are presented. The tests were performed with ABBOTT kits, Trisorb-125 being used for T_3 and Tetrasorb-125 being used for T_4. Comparative T_3-T_4 studies indicate inhibition in 66 cases. It was observed that a positive Werner inhibition is always accompanied by normal hormonemia and that negative inhibition is generally accompanied by hyperhormonemia. The results demonstrate the futility of carrying out inhibition tests when the free thyroxine index is increased as such tests would produce negative results. (FR)

8170 DETERMINATION OF RENAL CLEARANCE USING NUCLEAR MEDICINE TECHNIQUES. Method, Calculations, and Results. Oberhaussen, E.; Berterich, R.; Heinrich, W.; Globel, B. pp 396-400 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French)

From fourteenth colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

This method combines the evaluation of total renal clearance and two isotopic nephrograms, each providing sufficient information for calculation of this parameter. The calculations are effected from considerations of the beginning of the second phase of an isotopic nephrogram characterized by the selective accumulation of ^{131}I-labeled hippuric acid in the kidney and a reduction in the plasmatic and diffusion activity of the active substance in the extracellular space in the detector exploration zone. (FR)

8171 MEASUREMENT OF INTRARENAL BLOOD FLOW USING ^{133}Xe INJECTED INTO THE AORTA. Collard, M.; Guey, A.; Mehari, M. F.; Zech, P. Y.; Traeger, J.; Tran-Minh, V.; Pinet, A. (Hospital de l'Antiquaille, Lyon). pp 402-406 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French)

From fourteenth colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

Classical measurements of intrarenal blood flow are made by injecting ^{133}Xe into the renal artery. The simultaneous measurement of the flow in each kidney after a single injection of tracer in the aorta has advantages over the previous method of rendering possible a rigorous comparison of the flow in each kidney, enabling the effect of pharmacodynamic agents administered for diagnostic and therapeutic purposes to be studied, and overcoming the frequent impossibility of catheterizing a stenosed renal artery. The ^{133}Xe dose injected by the catheter in total aortography is of the order of 2.5 to 4 millicuries. (FR)

8172 APPLICATION OF ^{86}Rb AND ^{85}Rb AS POTASSIUM TRACER IN INVESTIGATIONS OF POTASSIUM NUTRITION OF PLANTS. Ivanov, S. N. (Scientific-Research Inst. for Soil Science and Agrochemistry, Minsk). Dokl. Akad, Nauk BSSR; 17: No. 8, 760-763(Aug 1973). (In Russian).

Two methods for using ^{86}Rb and ^{85}Rb as a K tracer are presented. In the first method, ^{86}Rb is used in the presence of ^{85}Rb in the feed solution in a ratio to K of 1:2. In the second method, only ^{85}Rb is used in a ratio in the feed solution of Rb to K of 1:2. Formulas are given for determining the coefficient of discrimination of Rb relative to K for ^{86}Rb and ^{85}Rb and for calculating the amount of K (% of total) entering from fertilizer. The possibility was shown of studying the uptake of N, P, and K by plants when they are introduced into the soil together. (tr-auth)

8173 STUDY OF PULMONARY CLEARANCE. Production of Calibrated Polystyrene Particles (Latex). Magdelenat, H. (Institut du Radium, Paris); Roy, M.; Gongora, R.; Gongora, G.; Jammet, H.; Bardy, A.; Beydon, J.; Hegesippe, H. pp 408-412 of Fourteenth Colloquium on Nuclear Medicine. Volume 3. Tours, France; Centre d'Etude des Methodes Physiques d'Exploration Fonctionnelle (1973). (In French)

From fourteenth colloquium on nuclear medicine. Vol. 3; Tours, France (9 Jun 1972).

When using aerosol techniques it is absolutely necessary to accurately determine the size and form of the particles employed. The particles must be chemically inert. The successive homogeneous depositing of (^{51}Cr) chromium acetylacetonate and polystyrene was effected on a calibrated latex surface, a 0.5 μ diameter polystyrene latex containing 1.1% of nonradioactive chromium acetylacetonate being used for the purpose. A pharmaceutical control was carried out; experimentation was then initiated on animals. The labeling stability and the pulmonary clearance after the inhaling of an aerosol were given particular attention. Applications to man are envisaged in the near future. (FR)

8174 DOUBLE ANTIBODY SOLID PHASE RADIOIMMUNOASSAY FOR HUMAN FSH. Seki, K.; Seki, K. (Chiba Univ., Japan). Nippon Sanka Fujinka Gakkai Zasshi; 25: No. 5, 427-428(May 1973). (In Japanese).

Double antibody solid phase (Dasp) was applied to the radioimmunoassay for follicle-stimulating hormone (FSH) in the human serum. Materials consisted of ^{131}I-labeled purified human pituitary FSH (LER 1366), LER 907 which was the pituitary standard of FSH and lutenizing hormone (LH), 2nd IRP-HMG, and anti-human pituitary FSH serum (Anti-HPFSH). Human chorionic gonadotropin (HCG) (12,000 IU/mg) and human pituitary LH (LER 960) were employed to examine the specificity. After the first incubation, 1 ml of anti-RGG immunosorbent (1:20) was added to the tube and it was further incubated (2nd incubation). The first incubation was continued for 96 hrs at 4°C and the second was for 2 hrs at room temperature. Reaction curves of various hormones to the dosage in these measurements were obtained, and the curve of LER 1366, LER 907, IRP-HMG, and the serum of women were parallel to each other. LER 960 did not react by the administration of less than 60 mg/ml and the purified HCG of Donini also did not react. Therefore, these measurements were not affected by LH and HCG, which were physiologically present in the blood. The serum FSH of a 24 year-old patient with opsomenorrhea, who was pregnant by the administration of clomiphene, was continuously determined during two cycles of these measurement methods. Dasp method was revealed simple to separate bound and free hormones. (JA)

8175 INCREASED SERUM PROLACTIN INDUCED IN HYPOPHYSECTOMIZED RATS BEARING ECTOPIC PITUITARIES. Malven, P. V.; Porteus, S. E. (Purdue Univ., Lafayette, IN). Proc. Soc. Exp. Biol. Med.; 144: No. 3, 956-959(Dec 1973).

A radioimmunoassay was developed for quantifying rat prolactin in blood serum, but the assay detected small amounts of immunoreactive prolactin in serum from hypophysectomized (Hx) rats. Prolonged anesthesia of these Hx rats with urethane significantly decreased their serum prolactin values, while prolonged anesthesia with pentobarbital (PB) had no significant effect. Transplantation of pituitary tissue (AP) to the renal capsule of Hx rats elevated serum prolactin, and this effect was produced with as little as ⅛ AP. Prolonged PB or urethane anesthesia combined with multiple blood sampling of Hx rats bearing ectopic AP significantly increased serum prolactin. The absence of stable prolactin concentrations in these rats suggests that prolactin release by ectopic AP may still be influenced by hypothalamic hypophysiotrophic hormones in the systemic circulation. (auth)

8176 BIOASSAY FOR THROMBOPOIETIN UTILIZING MICE IN REBOUND THROMBOCYTOSIS. McDonald, T. P. (Univ. of Tennessee, Knoxville). Proc. Soc. Exp. Biol. Med.; 144: No. 3, 1006-1012(Dec 1973).

A bioassay for the detection of the thrombopoietic stimulating factor (TSF or thrombopoietin) that utilizes thrombocythemic mice has been presented. A single injection of anti-mouse platelet serum (AMPS) to mice produced a characteristic thrombocytopenia that was followed by rebound thrombocytosis. Two to three days later (7-8 days after the AMPS injection), a significantly ($p < 0.05$) depressed thrombopoiesis existed in response to the thrombocytosis. Normal and thrombocythemic mice were injected with normal sheep sera or sera from platelet-depleted sheep and $Na_2{}^{35}SO_4$ incorporation into platelets was measured. A greater difference in ^{35}S uptake existed between AMPS-treated control mice (mice injected with normal sheep serum) and AMPS-treated stimulated mice (mice injected with serum from platelet-depleted sheep) than in normal mice treated with the same sera. Also, TSF in sheep sera was shown to lose activity after storage at -20°. (auth)

8177 ALANINE TURNOVER IN THE HUMAN: DETERMINATION OF THE SPECIFIC ACTIVITY. Gulli, R.; Searle, G. L. (Univ. of California, San Francisco). Proc. Soc. Exp. Biol. Med.; 144: No. 3, 830-833(Dec 1973).

A method for specific radioactivity analysis of alanine in blood is described. This analysis involves the separation of alanine by an ion exchange column technique and its subsequent isolation as a gravimetrically assayable sample (acetaldehyde-dimedon). Mass contamination of the acetaldehyde-dimedon from valine, which elutes from the ion exchange column close to alanine, is demonstrated to be negligible. Activity contamination of the acetaldehyde-dimedon from lactate and glucose, two significant products of alanine metabolism, is likewise demonstrated to be negligible. Sample counting rates have been demonstrated to be significantly above background (× 3) 2 hr following a single injection of 25 μCi L-[^{14}C] alanine to a human subject. (auth)

8178 ^{111}In-DTPA EVALUATION OF CSF DIVERSIONARY SHUNTS IN CHILDREN. Gilday, D. L.; Kellam, J. (Hospital for Sick Children, Toronto). J. Nucl. Med.; 14: No. 12, 920-923(Dec 1973).

One hundred and twenty-five CSF diversionary shunt patency studies were carried out in children using 2 μCi/kg of ^{111}In-DTPA. A total of four incorrect diagnoses occurred. The results were reproducible in 12 patients who had repeat studies without a change in clinical status. The radiopharmaceutical is considered safe since no reactions were observed and appears to be especially valuable for examining children because of the low radiation dose. As a result of the consistently reliable assessment of function of these shunts and a complete acceptance of the technique by our neurosurgeons, the number of air ventriculograms and surgical explorations for diagnosis in patients whose shunts were patent have been significantly reduced. (auth)

8179 DISTRIBUTION OF LABELED BLEOMYCIN IN NORMAL AND TUMOR-BEARING MICE. Grove, R. B.; Eckelman, W. C.; Reba, R. C. (Washington Hospital Center, DC). J. Nucl. Med.; 14: No. 12, 917-919(Dec 1973).

The chemotherapeutic drug bleomycin has been labeled with ^{57}Co, ^{111}In, ^{67}Ga, and ^{59}Fe. Chromatographic analysis indicates that ^{57}Co. ^{111}In, and ^{67}Ga label various bleomycin fractions. Distribution studies in Ehrlich carcinoma-bearing mice indicate that ^{67}Ga- and ^{111}In-bleomycin do not clear as rapidly from the blood and liver as ^{57}Co-bleomycin and should be used with caution as a substitute for the ^{57}Co compound. (auth)

8180 DIFFERENTIAL DIAGNOSIS OF BRAIN LESIONS BY GALLIUM SCANNING. Waxman, A. D.; Lee, G.; Wolfstein, R.; Siemsen, J. K. (LAC/USC Medical Center, Los Angeles). J. Nucl. Med.; 14: No. 12, 903-906(Dec 1973).

The effectiveness of gallium and technetium scanning was compared in the detection of brain tumors and to evaluate whether the combined use of both radionuclides might help in the differential diagnosis of tumors versus infarcts. Seventy-seven patients were studied, 28 with brain tumors and 43 with infarcts. Twenty-eight infarction cases had positive technetium brain scans while the gallium scan was negative. An additional nine cases showed a marked disparity between the technetium and gallium accumulation with the gallium study read as equivocal. In six cases no differential was possible since the gallium uptake approached that of technetium. Of the 28 intracranial neoplasms studied, nine showed gallium uptake to be greater than technetium uptake, using visual comparison of the density ratio in lesion to calvarium as criterion. In four of these cases the lesions were detected with gallium and not with technetium. Two cases showed gallium uptake slightly less than with technetium. It is concluded that ^{67}Ga scanning is a useful adjunct to brain scanning with ^{99m}Tc, particularly in the early detection of certain tumors as well as the differentiation of tumor from infarct. (auth)

8181 RADIOISOTOPE SYNOVECTOMY WITH ^{32}P-CHROMIC PHOSPHATE-KINETIC STUDIES. Winston, M. A.; Bluestone, R.; Cracchiolo, A. III; Blahd, W. H. (Veterans Administration Wadsworth Hospital Center, Los Angeles). J. Nucl. Med.; 14: No. 12, 886-889(Dec 1973).

In selected cases of rheumatoid disease, intrasynovial instillation of radionuclides may be used as a means of controlling recurring synovial effusions. In addition to an effective beta emission, the isotope chosen must be complexed into a stable particle that will be rapidly incorporated into the synovial tissue and remain there. ^{32}P-chromic phosphate was evaluated in nine patients following instillation into the knee joint. In eight of these, no leakage of radioactivity could be detected. In one case, beginning 4 days postinstillation, some migration of radioactivity to the ipsilateral inguinal nodes and, to a lesser extent, the sacrum and liver was found. This suggests that ^{32}P-chromic phosphate has greater stability than materials previously used. (auth)

MATERIALS

8182 NEW WAYS OF THE FUTURE SECURING OF RAW MATERIALS BY APPLYING NUCLEAR ENERGY. Merz, E.; Proplesch, P.; Zimmer, E. (Kernforschungsanlage, Juelich, Ger.). (1973). vp. (In German).

From 24th IUPAC congress; Hamburg, Germany (2 Sep 1973).

The increasing world need of nonferrous metals and the exhaustion of many terrestrial deposits in the future decades, makes opening up of the enormous deposited ore reserves in the form of thermal alkaline slurries and manganese modules in the world's seas worthwhile. The energy costs for drawing and processing of these play a particular role. The cost could be decreased by the use of relatively cheap nuclear energy. As it is uneconomical to transport the ore to be processed onto land, the use of a nuclear reactor has been suggested to generate electrical energy and process steam, either installed on a ship or on a working island, for the processing and chemical separation of these ores. The necessary basic chemicals can be obtained from the sediment slurries or from the seawater. The ecology of the sea is hardly disturbed by the whole process. The principle of the possible interconnected operation is explained using examples. (GE)

8183 MATERIALS (ENERGY) CRISIS: ITS CHALLENGES TO NDT AND ASNT. Ballard, D. W. (Sandia Labs., Albuquerque, NM). Mater. Eval.; 31: No. 12, 15A-18A; 20A-21A(Dec 1973).

A worsening materials and energy crisis facing our nation over the next quarter century is at hand. The demand for all kinds of material resources, whether estimated on a local, regional or global basis, is rapidly increasing at the very time when the supplies are diminishing or the quality of the raw materials is deteriorating. Most of the publicity on material shortages deals with energy fuels such as natural gas, petroleum, and radioactive materials. The energy fuels crisis is only one part of a much larger materials crisis since foodstuffs, industrial materials, and water are in short supply. Courses of action include an expansion of supply and a reduction in demand by conserving materials or maximizing their effectiveness throughout their life cycle. Nondestructive testing or evaluation has a unique opportunity to play a significant role in the conservation of materials. The magnitude of shortages, how it came to be, and solutions are discussed. (MCW)

Ceramics and Cermets

Refer also to abstracts 7539, 7564, 7567, 7570, 7621, 7652, 7654, 7843, 7870, 8278, 8341, 8625, 9346, 9354, 9355, 9370, 9380, 9415, 9421, 9486, 9536, 9656, 9657, 9663, 9672, 9685, and 9709.

8184 (AERE-PR/Met-7, pp 2.1-2.5) DEVELOPMENT OF SODIUM-BONDED MIXED-CARBIDE FUEL PINS FOR THE FAST REACTOR. Bellamy, R. G.; Paris, R. Sep 1973.

A design concept is described in which a large initial clearance between fuel and cladding accommodates fuel swelling, while excessive fuel temperatures and consequent rapid redistribution of the fuel to close this gap prematurely are avoided by filling it with sodium. The manufacture and irradiation performance are summarized. Safety studies are discussed. (UK)

8185 (AREAEE-163) EFFECT OF SINTERING ATMOSPHERES ON THE SINTERING OF URANIUM DIOXIDE. Haroun, N. A.; El Adham, K. A. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Sintering of UO_2 powder compacts pressed at 20,000 psi in different atmospheres was investigated. The effect of O/U ratio on sintering in nitrogen and in air was investigated; usually, an increased initial densification with increase of O/U ratio was noted. Sintering in hydrogen, nitrogen, and air was more effective at higher sintering temperatures. Only hydrogen sintering resulted in geometrically sound pellets. Densities in excess of 94% theoretical could be obtained at temperatures as low as 1300°C in hydrogen, indicating the activity of UO_2 powder used. (auth)

8186 (BNL-18324) SPIN WAVE RENORMALIZATION IN EuO. Glinka, C. J.; Minkiewicz, V. J.; Passell, L.; Shafer, M. W. (Brookhaven National Lab., Upton, N. Y. (USA)). [nd]. 10p. (CONF-731104-10). Dep. NTIS $3.00.

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

Inelastic neutron scattering techniques were used to measure the renormalization of large-q spin wave energies in EuO over the temperature range $0.05 \leq T/T_c \leq 0.95$. These data, together with extensive earlier measurements on small-q magnons in EuO, serve to characterize the renormalization over a wide range of temperature and over wave vectors extending throughout the Brillouin zone. Since EuO is a nearly ideal Heisenberg ferromagnet, such measurements provide a direct test of spin-wave theory at higher temperatures. Specifically, the data are compared with predictions of renormalization effects arising from two-magnon dynamical interactions. As expected, this description of the renormalization is found to be somewhat better for large q than for small-q magnons. (auth)

8187 (BNWL-SA-4803) CONCENTRATED DEFECTS IN PuO_2. Turcotte, R. P.; Chikalla, T. D. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-1830. 27p. (CONF-730956-1). Dep. NTIS $3.50.

From Battelle colloquium on defects in oxides; Columbus, Ohio, USA (17 Sep 1973).

The accumulation of concentrated defects in $^{238}PuO_2$ by self-radiation damage is shown to proceed by a simple exponential function for samples which are initially defect free. Anomalous behavior for both ingrowth and damage recovery is related to helium inventory, but not to uranium, which is the daughter product of the alpha decay. The annealing of samples having achieved a saturation of defects at 25°C proceeds through a two-stage mechanism, the first having an activation energy of 0.17 eV. Both defect production and annealing behavior are characterized by x-ray diffraction and electrical conductivity measurements for $25°C < T < 1000°C$. (auth)

8188 (CEA-R-4507) PHASE DIAGRAM AND THERMODYNAMIC PROPERTIES OF THE URANIUM–NEODYMIUM–OXYGEN SYSTEM. Wadier, J. F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). Nov 1973. 100p. (In French). Dep. NTIS (U. S. Sales Only) $7.00.

Thesis. Submitted to Paris Univ. (France).

The phase diagram of the U–Nd–O system at 850°C has been investigated and new orthorhombic phases have been demonstrated. In particular, the variations of the lattice parameter of the fcc phase have been extensively studied, since the deviation from stoichiometry (O/U + Nd = 2.00) arises from either a vacancy or an interstitial defect structure in the anion sublattice, without any discontinuity. Thermogravimetric measurements have yielded the variation of oxygen partial molar free enthalpy $\Delta\bar{G}(O_2)$ and the derived thermodynamic quantities, enthalpy and entropy. The observed discontinuity in $\Delta\bar{G}(O_2)$ at O/U + Nd = 2.00 was thus attributed to a predominant structural effect. The model of "surrounded atom" was applied to the description of the configuration of oxygen vacancies, which accounts for some of the experimental results. (auth)

8189 (HEDL-SA-587) THERMAL PROPERTIES OF B_4C AND Eu_2O_3. Gibby, R. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1 Oct 1973. 23p. (CONF-731041-2). Dep. NTIS $3.25.

From American Ceramics Society nuclear division meeting; San Francisco, California, USA (29 Oct 1973).

Results of studies on the thermal conductivity of Eu_2O_3 and heat capacity of B_4C are presented. The data obtained for irradiated and unirradiated B_4C show no significant effect of irradiation on enthalpy and heat capacity. The enthalpy and heat capacity of B_4C can be expressed as a function of temperature between room temperature and approximately 1400°C by the equation: $H(T) - H(298) = -10884 + 23.29T + 0.274 \times 10^{-2}T^2 + 1.103 \times 10^6/T$ $Cp = 23.29 + 0.548 \times 10^{-2}T - 1.103 \times 10^6/T^2$. The thermal diffusivity of the cubic Eu_2O_3 was approximately 29% higher than that of monoclinic Eu_2O_3 at 100°C. The calculated thermal conductivity of monoclinic Eu_2O_3 was approximately 30% less than other reported data at ≤ 500°C. The lower temperature data, however, agree with data reported for an isomorphous compound, Pm_2O_3. The data are also more consistant with the results expected for a material of low crystal symmetry, based on the thermal conductivity reported for monoclinic ZrO_2. The thermal conductivity of cubic Eu_2O_3 is approximately 19% higher than the monoclinic oxide at 100°C, but decreases with temperatures to values at approximately 11% higher just below the transition temperature. (JRD)

8190 (IS-RIC-6) THERMOCHEMISTRY OF THE RARE EARTHS. Part I. Rare Earth Oxides. Part II. Rare Earth Oxysulfides. Part III. Rare Earth Compounds With B, Sn, Pb, P, As, Sb, Bi, Cu, and Ag. Gschneidner, K. A. Jr.; Kippenhan, N. A.; McMasters, O. D. (Iowa State Univ. of Science and Technology, Ames (USA). Inst. for Atomic Research). Aug 1973. 67p. Dep. NTIS $5.50.

For Molybdenum Corp. of America, White Plains, NY.

This is a continuation of a study and an analysis of thermochemical data of the rare earth compounds which may be formed when rare earths are added in the manufacture of steal and iron. Existing data on the oxides are critically evaluated, and the heats and free energies of formation are tabulated and graphed as functions of temperature. Formation heats and energies are estimated for rare earth oxysulfides; data are given for Gd_2O_2S, Ce_2O_2S, and Y_2O_2S as functions of temperature. Available data for the other rare earth compounds are summarized; estimates are made for these containing P, Bi, Cu, and Ag. (33 tables, 4 figures, 98 references) (DLC)

8191 (HEDL-SA-589) STRUCTURE AND IRRADIATION EFFECTS ON PORE MORPHOLOGY IN BORON CARBIDE. Christensen, J. A.; Ross, W. A.; Basmajian, J. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-2170. 12p. (CONF-731041-1). Dep. NTIS $3.00.

From American Ceramics Society nuclear division meeting; San Francisco, California, USA (29 Oct 1973).

The fractional open porosity in hot-pressed B_4C was determined by mercury porosimetry over the density range from 80% to 97% of theoretical density (TD). Specimens from twenty different batches of materials with different processing histories were examined. The results show that below approximately 90% TD, virtually all of the porosity present in the pellets is open. Between 90 and 94% TD, the fractional open porosity drops to nearly zero; and at densities higher than 94% TD, all of the pores in the pellets are closed. These measured trends correlate well with qualitative metallographic observations of pore morphology. Pore-size distributions were also measured for twenty different B_4C specimens irradiated in EBR-II to exposures ranging from 4×10^{20} to 16×10^{20} captures/cm^3 at temperatures from 1100 to 1600°F. These irradiation conditions affected porosity characteristics relatively little. In general, there was a shift in bulk density to lower values that were commensurate with the amount of swelling deduced from dimensional measurements on these pellets. Apparently, irradiation-induced swelling is not internally accommodated in existing fabrication porosity. Attempts to relate pore type to He release fraction showed similarly that no correlation exists. (auth)

8192 (ITJ-39) MAGNETIC INVESTIGATIONS OF SEVERAL RARE EARTH OXIDES. Schreiner, P.; Czopnik, A. (Akademia-Gorniczo-Hutnicza, Krakow (Poland). Instytut Techniki Jadrowej). Mar 1973. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

The results of the magnetic susceptibility measurements for neodymium sesquioxide and nonstoichiometric praseodymium oxide at 1.5 to 300°K and for nonstoichiometric terbium oxide at 4.2 to 300°K are reported. These rare earth oxides proved to be neither antiferromagnetic nor ferromagnetic. For the most ordered form of neodymium sesquioxide there are two characteristic temperatures: −37 and −5°K. For $TbO_{1.75}/Tb_4O_7/$ the results of the measurements are similar to the results for $TbO_{1.889}$, and are different from results for other nonstoichiometric Tb−O phases. For $PrO_{1.8333}/Pr_6O_{11}/$ the susceptibility curve is not linear and is in agreement with the data in the literature. (auth)

8193 (N-73-26672) EXPERIMENTAL EVALUATION OF THERMAL RATCHETING BEHAVIOR IN UO_2 FUEL ELEMENTS. Phillips, W. M. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 1 Jul 1973. Contract NAS7-100. 16p. (NASA-CR-133236; JPL-TM-33-622). NTIS $3.00.

The effects of thermal cycling of UO_2 at high temperatures was experimentally evaluated to determine the rates of distortion of UO_2/clad fuel elements. Two capsules were tested in the 1500°C range, one with a 50°C thermal cycle, the other with a 100°C thermal cycle. It was observed that eight hours at the lower cycle temperature produced sufficient UO_2 redistribution to cause clad distortion. The amount of distortion produced by the 100°C cycle was less than double that produced by the 50°C, indicating smaller thermal cycles would result in clad distortion. An incubation period was observed to occur before the onset of distortion with cycling similar to fuel swelling observed in-pile at these temperatures. (auth)

8194 (N-73-28590) THERMOPHYSICAL PROPERTIES OF PLASMA-SPRAYED COATINGS. Wilkes, K. E.; Lagedrost, J. F. (Battelle Columbus Labs., Ohio (USA)). Mar 1973. Contract NAS3-13329. 148p. (NASA-CR-121144). NTIS $9.50.

Thermophysical properties of plasma-sprayed materials were determined for the following plasma sprayed materials: CaO-stabilized ZrO_2, Y_2O_3-stabilized ZrO_2, Al_2O_3, HfO_2, Mo, nichrome, NiAl, Mo−ZrO_2, and Mo−Al_2O_3 mixtures. In all cases the thermal conductivity of the as-sprayed materials was found to be considerably lower than that of the bulk material. The flash-laser thermal-diffusivity technique was used both for diffusivity determination of single-layer materials and to determine the thermal-contact resistance at the interface of two-layer specimens. (auth)

8195 (ORNL-tr-2730) STRUCTURAL PHASE TRANSITIONS IN THE NbH SYSTEM. Pick, M. A. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Festkoerperforschung). May 1973. Translation by R. G. Mansfield of JUL-951-FF. 67p. Dep. NTIS $5.50.

The phase diagram of the NbH system was studied by x-ray diffraction, neutron scattering, and metallography. The $\alpha \rightarrow \alpha'$ transition can be explained as a consequence of elastic dipole−dipole interaction. From the β-phase lattice parameter, an additional interaction, the direct H−H interaction, plays a critical role in the order−disorder $\alpha' \rightarrow \beta$ transition. A new phase, γ, was found which is stable within the β-phase region at low temperatures. The double-force tensor was determined and the orthorhombic distortion model was further applied to Ta and V hybrids. (32 figures, 84 references) (DLC)

8196 (WANL-TME-589) IODINE AND TELLURIUM RELEASE FROM UC_2 GRAPHITE FUEL. Henninger, W. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Jan 1964. Contract SNP-1. 15p. Dep. NTIS $3.00.

Declassified 29 Aug 1973.

An estimation of the quantity of radioiodine released from NERVA fuel, under various conditions, is required because of its potential biological hazard to both on-site and off-site occupants during normal reactor operations and in the event of a reactor excursion. The amount of tellurium released is also important because it is the immediate precursor to iodine and much of the iodine activity to be found in test effluents will be the result of tellurium diffusion. The fuel specimens were irradiated at 100 watts in fluxes to produce about 10^{10} fissions per specimen. The results show that iodine is released at a faster rate than tellurium at the higher temperatures studied. There was no release observed for either element, however, at 2000°C in vacuum for 20 minutes. It was also found that release for both elements was retarded by increasing pressure. (JRD)

8197 HIGH-TEMPERATURE OXIDATION OF ZIRCONIUM BORIDE IN OXYGEN. Lavrenko, V. A.; Glebov, L. A.; Lugovskaya, E. S. (Inst. of Materials Science, Kiev). Russ. J. Phys. Chem. (Engl. Transl.); 47: No. 4, 502-504(Apr 1973).

Translated from Zh. Fiz. Khim.; 47: No. 4, 887-891(Apr 1973).

The growth kinetics of oxide films on zirconium boride exposed to oxygen at high temperatures were investigated as a function of temperature and oxygen pressure. The phase composition of the scale formed on ZrB_2 under different conditions is discussed. (auth)

8198 TEMPERATURE DEPENDENCE OF ^{51}V NMR IN V_2O_3 UP TO 1000°K. Mizoguchi, M.; Iida, S. (Tokyo Univ.). J. Phys. Soc. Jap.; 35: No. 1, 302(Jul 1973).

The frequency shift and magnetic susceptibility were measured at 290 to 960°K. A shift vs susceptibility plot shows a discontinuity between 460 and 560°K, corresponding to the gradual metal-insulator phase transition. The slopes give hyperfine fields of −140 kOe/μ_B at low temperatures and −82 kOe/μ_B at high temperatures. (DLC)

8199 EPR STUDY OF REACTOR-IRRADIATED POLYCRYSTALLINE α-Al_2O_3 AND DEFECTIVE ASPECTS IN α-Al_2O_3 SYSTEMS. Galli, A. (CNEN, Rome). Nuovo Cim.; 18B: No. 1, 11-40(11 Nov 1973).

Effects of in-pile γ or mixed (neutron and γ) irradiation on sintered alumina (polycrystalline α-Al_2O_3), as studied by EPR spectra, are considered in the light of similar studies on single crystals. The absorption lines can be divided into groups, most of which are due to as many paramagnetic centers. Single trapped holes adjacent to cation vacancies, single electrons trapped at anion vacancies, and Al ion pairs are the more important paramagnetic centers observable at room temperature in consequence of mixed irradiation performed at the normal reactor temperature (~45°C). Trapped-hole g-tensor turns out to be characterized by $g_\perp = 2.033 \pm 0.004$ and $g_{||} = 1.988 \pm 0.004$, and then by an anisotropy $g_\perp - g_{||} = 0.046 \pm 0.004$, by far higher than the ones considered in single crystals. The disagreement might be due to hiding effects in crystals of trapped electron contribution. Possible implications of the larger anisotropy in optical absorption spectroscopy are mentioned. Trapped electrons behave like F-centers and are characterized by $g = 2.007 \pm 0.004$. Growth kinetics of the main centers are considered: low- and high-dose effects are rather clearly pointed out and particular interpretations are sometimes looked into. An attempt is made to weigh the role of defects present before the irradiation. Other possible effects are briefly mentioned. (7 tables, 7 figures) (auth)

8200 OPTICAL ABSORPTION BY THE FRENKEL EXCITON IN V_2O_3. Andrianov, G. O.; Aronov, A. G.; Smirnova, T. V.; Chudnovskii, F. A. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Status Solidi (b); 60: No. 1, 79-84(1 Nov 1973).

Results are presented of an experimental study of the polarized-light absorption spectra of V_2O_3 at the fundamental absorption edge. It is shown that the absorption spectra can be described within the framework of the theory of optical absorption of Frenkel excitons which strongly interact with phonons. (auth)

8201 OPTICAL ABSORPTION BY FREE POLARONS IN CdO. Finkenrath, H.; Fricke, W.; Uhle, N. (Technische Hoschchule, Darmstadt, Ger.). Phys. Status Solidi (b); 60: No. 1, 341-344 (1 Nov 1973).

The optical constants of degenerate CdO films were measured at about 10°K in the spectral range around the LO lattice frequency (5 to 24 μm). Besides the free carrier absorption and a tail of the lattice absorption, an additional absorption is found above the LO frequency which can be explained by the theory of free polarons. At higher frequencies, it is superimposed by further absorption processes with noticeable structure which are unexplained until now. (auth)

8202 INVESTIGATION OF HIGH-TEMPERATURE OXIDATION OF LANTHANUM HEXABORIDE IN OXYGEN AND THE EFFECT OF INTERNAL OXIDATION ON THE PROTECTIVE PROPERTIES OF THE SCALE. Lavrenko, V. A.; Glebov, L. A.; Lugovskaya, Y. S.; Frantsevich, I. N. (Materials Research Inst., Kiev). Oxidation Metals; 7: No. 2, 131-139(Oct 1973).

The vacuum microbalance method as well as petrographic and x-ray phase analysis were employed to investigate the oxidation of lanthanum hexaboride as a function of temperature (700 to 1200°C), oxygen pressure (0.1 to 740 torr), and porosity of the sample. It was established that LaB_6 is highly resistant to oxidation in oxygen up to a temperature of 1200°C. The protective properties of the scale are determined by the peculiarities of the process of internal oxidation, during which a lower lanthanum boride, LaB_4, was observed to be enveloped by the vitreous oxide phase, B_2O_3. (auth)

8203 SODIUM URANIUM BRONZE AND RELATED PHASES. Greaves, C.; Cheetham, A. K.; Fender, B. E. F. (Oxford Univ.). Inorg. Chem.; No. 12, 3003-3007(Dec 1973).

The possibility that the ions Na^+, Ca^{2+}, Mg^{2+}, and In^{3+} may be incorporated into the α-UO_3 structure was investigated. Of these ions only Na^+ is readily introduced to form a nonmetallic uranium bronze Na_xUO_3 ($0 < x < 0.14$). Powder neutron diffraction and infrared spectroscopy results indicate that the Na^+ ions occupy the vacant sites in the α-UO_3 structure up to the expected sodium limit of about 12% of the total cation sites. Under oxidizing conditions, all the uranium is oxidized to U(VI) to give a related nonstoichiometric phase of upper limit $Na_{0.165}U_{0.373}O_3$. At low oxygen pressures and low sodium contents, on the other hand, reduction occurs leading to the formation of new phases with compositions M_3O_8 and $M_{22}O_{38}$ (where M = Na + U). (auth)

8204 SOLUBILITY OF BORON IN COBALT. Lerner, C.; Cadeville, M. C. (Equipe de Recherche sur la Structure Electronique des Solids, Strasbourg). Scr. Met.; 7: No. 9, 941-944 (Sep 1973). (In French).

X-ray and residual resistivity measurements were made on Co–B solid solutions. The results showed that the solubility of B in Co is low, ~0.2 at.%. The solid solution is of the interstitial type. The B, just like C, stabilizes the face-centered-cubic phase of the Co to the detriment of the hexagonal phase. (JSR)

8205 IRON-CHROMIUM-BORON SYSTEM. COEXISTENCE RELATIONS AT THE SOLID STATE BETWEEN THE PHASES OF THE SYSTEM AT 1250°C. Lucco Borlera, M.; Pradelli, G. (Politechnico, Turin). Met. Ital.; 65: No. 7-8, 421-424(1973). (In Italian).

The 1250°C isothermal section of the Fe–Cr–B ternary system with a boron content up to 50 at. % was studied. In this area, compound fields of six solid solutions were determined. In the iron borides, Fe_2B (tetragonal) and FeB (rhombic), a substitution of respectively 24 and 50% of the Fe atoms by Cr atoms can occur. In the β phase (hexagonal) of the Cr–B system, minimal quantities of iron are dissolved; on the contrary, in the phases γ-Cr_2B (rhombic), δ-Cr_5B_3 (tetragonal), and ϵ-CrB (rhombic), the Cr–Fe substitution can reach 72, 20, and 40 at. %, respectively. (auth)

8206 PLASMA SPRAYING OF REFRACTORY SURFACES WITH COMPOSITE POWDERS. Lammer, J.; Benesovsky, F. (Metallwerk Plansee AG, Reutte/Tirol, Austria). Planseeber. Pulvermet.; 21: No. 1, 18-33(Mar 1973). (In German).

WC–Co cemented carbide containing 16.8 % Co were applied to the surfacing of steel and molybdenum by means of a plasma gun. A novel compound powder in which a polycrystalline core is surrounded by a cobalt layer was used. The density, hardness, transverse rupture strength, adhesion and shear strength as a function of the arc current were determined. The oxygen and carbon balance in the alloy as a function of the arc current were also investigated. The presence of phases from the system W–Co–C was revealed by metallographic and electron microscope and x-ray studies. Owing to the extreme temperature and cooling conditions, local nonequilibrium states occur in the coatings, which greatly affect the mechanical properties. These states can be eliminated by an annealing treatment, resulting in coatings with a structure analogous to that of the sintered alloy. The WC–Co compound powder is thus technologically superior, yielding improved cemented carbide spray coatings, compared with previously used powder mixtures. (14 figures) (auth)

8207 PRODUCTION, STRUCTURE, AND HARDNESS PROPERTIES OF THE SYSTEM Ta–Hf–C–N. Komac, M. (Institut Jozef Stefan, Ljubljana, Czech.); Thuemmler, F. Planseeber. Pulvermet.; 21: No. 2, 88-109(Jun 1973). (In German).

In the pseudoternary system TaC_{1-x}–TaN_x–HfN, samples were hot pressed to 85 to 95% TD and annealed afterwards. Special attention was drawn to the binaries TaC_{1-x}–TaN and TaC_{1-x}–HfN as well as the ternary composition with 80 and 60 mol % TaC_{1-x}. The following were investigated: The boundaries of the cubic phase, lattice parameters and microhardness at room temperature versus compositions, microhardness of special compositions up to 1000°C. The nitrogen-containing samples show considerably higher hardness numbers than $TaC_{1.0}$ that can be explained in terms of valence electron concentration. Nevertheless, the carbonitrides do not reach the maximum hardness of TaC_{1-x} at room temperature. Probably in both tantalum carbonitrides and TaC_{1-x}, the deviations from stoichiometry are probably responsible for the hardness increase and the nitrogen content does not contribute for itself in this respect. TaC–HfN exhibits maximum hardness values in the medium range. The highest hardness values at high temperatures show (TaHf) (CN), due to its relatively low temperature dependence of hardness. A favorable composition with this respect is 60 TaC/20 HfN/20 TaN. Such compositions could be important for hard metal technology. It is shown that a conclusive discussion of properties of these mixed phases would be valuable only as thorough consideration of the metalloid : metal ratio. (22 figures, 5 tables, 21 references) (auth)

8208 SINTERING OF MILLED WC POWDER IN THE PRESENCE OF COBALT. Bengtsson, B. (Chalmers Univ. of Tech., Goteborg); Johannesson, T.; Lindau, L. Planseeber. Pulvermet.; 21: No. 2, 110-120(Jun 1973).

In order to establish the relationship between the milling and sintering of WC–Co powder in the production of cemented carbide, the sintering of milled WC powder mixed with unmilled Co powder was studied. The as-received powder was characterized by x-ray line broadening analysis, chemical analysis, and scanning electron microscopy. Using a temperature program similar to those used in production, the shrinkage during sintering was followed with a dilatometer and the structural development with a scanning electron microscope. Although the dislocation density is much higher in the heavily miller WC powder than in the lightly milled WC powder, the same mechanism is active during the initial stages of sintering. The shrinkage is, however, faster in the heavily milled powder mixture and about 75% of the total shrinkage takes place before the binder metal has melted. In this case a continuous structure is developed at an earlier stage and the pore elimination is more efficient than in the lightly milled powder. (auth)

8209 STUDY OF THE PROPERTIES OF STIMULATED RADIATION FROM A RUBY LASER ON IRRADIATION BY ^{60}Co γ RAYS. Bedilov, M. R.; Khaidarov, R. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 87-90(1973). (In Russian).

A ruby rod 75 mm long and 7.5 mm in diameter was given gamma doses of $0 - 10^7$ R at a dose rate of 100 R/sec. After each irradiation the laser properties were restored by a thermal anneal at a temperature of 800°C. The properties of laser emission before and after gamma irradiation were investigated by photoelectric, calorimetric, spectral, and photographic methods. Before and after irradiation at doses of 10^4, 10^5, 10^6, and 10^7 R, respectively, the initial generation lag time (from the beginning of pumping) increased from 260 to 290, 323, 415, and 472 ms, while the duration of the laser pulse decreased from 690 to 615, 538, 353, and 338 μs, respectively. The energy of laser emission before and after radiation doses of 10^4, 10^5, 10^6, and 10^7 R is equal, respectively, to 1.8 and 1.6, 1.4, 0.9 and 0.8 joules at an electric pumping energy of 4.3 kjoules, while the generation threshold of the laser increases from 1.45 to 1.8, 3.0, and 3.75 kjoules. The laser generates at a wavelength of 6943 A. The intensity of the spectral

emission of the laser starts to decrease at a dose of 10^4 R with the lowest intensity being attained at the highest irradiation dose of 10^7 R. The cross-sectional light intensity decreased from a spot size of 0.8 cm in diameter before irradiation to a spot size of 0.6 cm in diameter after an irradiation dose of 10^7 R. A substantial decrease in laser yield was noted at gamma doses of 10^4 to 10^6 R at a concentration of 0.05% Cr^{+3} in the ruby laser. These changes can be explained by a decrease in concentration of the Cr^{+3} activator, which is converted to Cr^{+2} or to Cr^{+4}. (SJR)

8210 KINETIC MEASUREMENTS FOR THE CARBOTHERMIC SYNTHESIS OF UN, PuN, AND (U,Pu)N. Greenhalgh, W. O. (Westinghouse Electric Co., Richland, WA). J. Amer. Ceram. Soc.; 56: No. 11, 553-557(Nov 1973).

A kinetic study of the synthesis of nitrides using carbothermic reduction of UO_2 and PuO_2 in flowing N_2 was conducted. Reaction rate constants as functions of the reaction temperature and N_2 flow rate were determined. The measured rate constants varied with temperature according to the Arrhenius equation at constant N_2 flow rates. In logarithmic form, the measured rate constants also varied linearly with N_2 flow rate at constant temperature, up to a flow rate of 120 cm^3/min-g of reactant. The rate constant for a particular reaction temperature and N_2 flow rate can be calculated from the logarithmic form of the Arrhenius equation by adding a flow-rate term, F. The expression $\ln k = (-86{,}000/RT) + 18.1 + 0.021F$ fits the kinetic data from 1430 to 1625°C. Close agreement was obtained between calculated and experimental rate constants determined for 50-g batch production runs. The reaction rates measured are considered rapid enough for an economical nitride process. (6 figures, 3 tables) (auth)

8211 HOT-PRESSING AND PROPERTIES OF Be_4B. Dutta, S. K. (Army Materials and Mechanics Research Center, Watertown, MA); Rubin, J. A. J. Amer. Ceram. Soc.; 56: No. 11, 609 (Nov 1973).

Be_4B was hot-pressed to theoretical density at 1030°C and 3000 psi. It contained 5% impurities, mainly BeO and Be, which accounted for the high density (1.96 vs 1.94 g/cm^3 theoretical). The various phases in its microstructure were analyzed. The average grain diameter was 17 μm, with a distribution from 5 to 31 μm. Microhardness was measured to be 1350 kg/mm^2; the average modulus of rupture and the elastic modulus were 25,608 ± 3,000 and 34.5 × 10^6 psi, respectively. (DLC)

8212 PROPOSED PHASE RELATIONS IN THE HfO_2-RICH PORTION OF THE SYSTEM Hf–HfO_2. Ruh, R. (Air Force Materials Lab., Wright-Patterson Air Force Base, OH); Patel, V. A. J. Amer. Ceram. Soc.; 56: No. 11, 606-607(Nov 1973).

From seventy-second annual meeting, the American Ceramic Society; Philadelphia, PA (5 May 1970).

Compositions were investigated between 50 and 66.7 at. % O, and temperatures of 1800 to 2200°C were used. The HfO_2 was the continuous phase; the α-Hf appeared in the form of striations, a grain-boundary phase, and/or particles at grain boundaries or within the HfO_2. The microstructures are interpreted as follows: at 2200 to 2150°C, cubic HfO_2 + α-Hf are present. When the cubic HfO_2 is quenched, it transforms to tetragonal HfO_2, resulting in α-Hf striations. At ≤ 2100°C, the quenched samples did not undergo the cubic-tetragonal inversion, and no striations were found. No changes in lattice parameters were observed between O-deficient and stoichiometric HfO_2. A tentative phase diagram is given. (DLC)

8213 ANOMALOUS ELASTIC BEHAVIOR OF POLYCRYSTALLINE Nb_2O_5. Manning, W. R.; Hunter, O. Jr. (Ames Lab., Iowa). J. Amer. Ceram. Soc.; 56: No. 11, 602-603(Nov 1973).

The Young's modulus was determined as a function of density and temperature for hot-pressed and sintered Nb_2O_5. Results for the hot-pressed samples showed a linear density dependence, whereas the sintered samples showed no correlation with density. The modulus of the sintered, but not the hot-pressed, samples showed hysteresis on heating and cooling. Results indicate that sintered Nb_2O_5 is subject to internal microcracking. (DLC)

8214 PSEUDOBINARY Ti–ZrO_2. Domagala, R. F. (Univ. of Illinois, Chicago); Lyon, S. R.; Ruh, R. J. Amer. Ceram. Soc.; 56: No. 11, 584-587(Nov 1973).

The vertical section Ti–ZrO_2 within the Ti–Zr–O system was investigated by metallographic, x-ray-diffraction, electron-probe, and melting-point studies. Analyses were conducted using arc-melted specimens that had been equilibrated and quenched from temperatures of 600 to 1600°C. The Ti–ZrO_2 section is similar to the Zr–ZrO_2 system. At high temperatures, considerable amounts of Zr and O go into solid solution in Ti, stabilizing α-Ti to 30 wt% ZrO_2. From 30 to 98 wt% ZrO_2, an α-Ti + ZrO_2 region is defined, and at compositions above 98 wt% ZrO_2, single-phase ZrO_2(ss) exists. At low temperatures, an α-Ti + $(Ti,Zr)_3O$ field exists from 22 to 32 wt% ZrO_2; this region decreases in size with increasing temperature until it disappears at 1200°C. Above 32 wt% ZrO_2, a three-phase α-Ti + $(Ti,Zr)_3O$ + ZrO_2 field exists; its stability extends from 1200°C at 30 wt% ZrO_2 to <500°C at ≈ 77 wt% ZrO_2. (8 figures) (auth)

8215 HEAT OF VAPORIZATION OF EuN AND ITS STANDARD HEAT OF FORMATION. Kordis, J. (Texas A and M Univ., College Station); Gingerich, K. A.; Kaldis, E. J. Amer. Ceram. Soc.; 56: No. 11, 581-583(Nov 1973).

The vaporization of EuN was studied by Knudsen effusion mass spectrometry with Mo Knudsen cells of 0.010- and 0.020-in. orifice diameter. Europium nitride has a narrow N-deficient homogeneity range and vaporizes congruently by dissociation into Eu vapor and N_2. No gaseous EuN was observed. The second-law enthalpy change for the reaction $EuN_{1-x}(s) = Eu(g) + [(1-x)/2]N_2(g)$, where x is very small, was $\Delta H^\circ_{298} = 94 \pm 6$ kcal (393.3 ± 25.1 kJ). In conjunction with the heat of vaporization of Eu, the standard heat of formation of EuN, $\Delta H^\circ_{f,298} = -52 \pm 6$ kcal mol^{-1}(217.6 ± 25.1 kJ mol^{-1}), was obtained. (auth)

8216 Cs_2MoO_4–MoO_3 SYSTEM. Hoekstra, H. R. (Argonne National Lab., IL). Inorg. Nucl. Chem. Lett.; 9: No. 12, 1291-1301(Dec 1973).

The Cs_2MoO_4–MoO_3 system was investigated by powder x-ray diffraction, thermal analysis, and infrared and Raman spectral studies. Five cesium polymolybdates were identified: $Cs_2Mo_2O_7$, $Cs_2Mo_3O_{10}$, $Cs_2Mo_4O_{13}$, $Cs_2Mo_5O_{16}$, and $Cs_2Mo_7O_{22}$. (auth)

8217 NUCLEAR FUEL COMPACTS: OVERCOATING DRUM MODIFICATIONS ESPECIALLY FOR LARGE GRAIN SIZE DISTRIBUTION OF OVERCOAT POWDERS. Sturge, D. W. J.; Davies, T. A. (to Dragon). British Patent 12,017/71. 28 Apr 1971.

Available from the Commission of European Communities, Luxembourg.

A common method for overcoating nuclear fuel spheroids which have been already coated with a fission product-retaining layer consists in tumbling a batch of spheroids in a rotating drum whilst simultaneously introducing the constituents of the overcoating, such as a graphite, a polymerisable resin, and a binder. Experience with this process shows that difficulties arise in using overcoating powder above a certain median grain size (about 70 μm). The present process extends the range of grain size. It consists in introducing grains of dry powdered overcoating material including a binder onto tumbling spheroids of nuclear fuel and simultaneously applying a film of liquid solvent for the binder. (EU)

8218 DIPOLAR-DOMINATED CRITICAL BEHAVIOR OF EuO. Salamon, M. B. (Univ. of Illinois, Urbana). Solid State Commun.; 13: No. 10, 1741-1745(15 Nov 1973).

Through a careful analysis of specific heat data for EuO, evidence was found which supports the conclusion that, for ferromagnets, a crossover from Heisenberg-like to dipolar critical behaviour occurs at a reduced temperature $|t| \sim 2 \times 10^{-2}$. In the Heisenberg regime, the critical exponents are found to be $\alpha = \alpha' = -0.09 \pm 0.01$ while in the dipolar region $\alpha = \alpha' = -0.026 \pm 0.005$. (auth)

8219 HIGH-TEMPERATURE PHASES, CRYSTAL STRUCTURES, AND THE MELTING POINTS FOR SEVERAL OF THE TRANSPLUTONIUM SESQUIOXIDES. Baybarz, R. D. (Oak Ridge National Lab., TN). J. Inorg. Nucl. Chem.; 35: No. 12, 4149-4158(Dec 1973).

The monoclinic form of Bk_2O_3 and the hexagonal forms of Bk_2O_3 and Cf_2O_3 have been prepared. The monoclinic structure of Bk_2O_3 was obtained in the range 1200 to 1700°C and was found to have lattice parameters of $a_0 = 14.197 \pm 0.007$ Å, $b_0 = 3.606 \pm 0.003$ Å, $c_0 = 8.846 \pm 0.005$ Å and $\beta = 100.23 \pm 0.09°$. At temperatures above 1750°C, the monoclinic form of Bk_2O_3 transformed to a hexagonal structure having room-temperature lattice parameters of $a_0 = 3.754 \pm 0.002$ Å and $c_0 = 5.958 \pm 0.002$ Å. The hexagonal form of Cf_2O_3 was also prepared and the lattice parameters determined to be $a_0 = 3.72 \pm 0.01$ Å and $c_0 = 5.96 \pm 0.01$ Å. The mp of Cm_2O_3, Bk_2O_3, and Cf_2O_3 were measured and the values observed to be 2260, 1920, and 1750°C respectively. A stability diagram for several of the actinide sesquioxides was constructed. (auth)

8220 NEW MELTING PROCESS FOR MAKING SPHEROIDS. North, J. M. (United Kingdom Atomic Energy Authority, Harwell, Eng.). Trans. J. Brit. Ceram. Soc.; 72: No. 7, 313-318(Nov 1973).

A process is described for preparing spheroids of metals and refractory materials such as uranium monocarbide, alumina, uranium dioxide, and zirconia. A continuous feed is arc-melted in a rotating crucible and the melt is flung over the crucible edge and solidifies in flight as spheroids. By varying the crucible rotation speed, spheroids within the size range 200 to 2,000 μm diameter can be produced. By melting in various atmospheres, some control of the stoichiometry of Al_2O_3, UO_2, and ZrO_2 can be obtained. (auth)

8221 TRANSFORMATION TWINS AND ELASTIC PROPERTIES OF U_3Si AT LOW TEMPERATURES. Rosen, M.; Gefen, Y.; Kimmel, G.; Halwany, A. (Israel Atomic Energy Commission, Negev). Phil. Mag.; 28: No. 5, 1007-1014(Nov 1973).

The elastic properties, adiabatic compressibility, and Debye temperature of twinned and nontwinned U_3Si were determined by means of an ultrasonic-pulse technique between liquid helium temperature and ambient. The twinned and nontwinned face-centred tetragonal U_3Si specimens were prepared employing appropriate heat-treatment regimes. The presence of twins in the U_3Si lattice yields a modulus defect of about 18.5%, the Young's modulus of the twinned U_3Si having the lower absolute value. At about 85°K, the twinned structure displays a prominent minimum in its elastic properties, suggesting a first-order phase transformation. In contrast, the nontwinned U_3Si exhibits a maximum in this temperature range. Experimental results are discussed in terms of the effect of twins on the lattice stability of the tetragonal structure of U_3Si. (auth)

8222 PRODUCTION OF SILICON CARBIDE. Voice, E. H. (to Dragon). British Patent 46,757/71. 7 Oct 1971.

Available from the Commission of European Communities, Luxembourg.

The deposition of silicon carbide coatings on nuclear fuel spheroids is effected by contacting them at high temperature with methyltrichlorosilane vapour, using hydrogen as a carrier gas. Additives like nitrogen, water vapour, phosphorus, or arsenic improve the crystal structure of the coating. (EU)

8223 PREPARATION OF FILTERABLE COPRECIPITATE OF PLUTONIUM AND URANIUM. Lyon, W. L. (to United States Atomic Energy Commission). Danish Patent 125,584. 12 Mar 1973. Filed date 11 Aug 1965. 6p. (In Danish).

A process is described for producing a homogeneous plutonium oxide–uranium oxide fuel for a nuclear reactor. An easily filtered hydrous oxide mixture of plutonium and uranium is coprecipitated from an acidic feed solution containing plutonium and uranium in a mole concentration ratio between about 0.7 and 1.5 by the addition of ammonium hydroxide. The precipitate is washed, dried, and reduced in a hydrogen atmosphere, then mixed and blended with reactor-grade uranium oxide to adjust the plutonium–uranium ratio to the desired value. (DE)

8224 MANUFACTURE OF NUCLEAR FUEL POROUS PARTICLES. Billson, N. L.; Lefevre, R. L. R. (to United Kingdom Atomic Energy Authority). British Patent 36,528/71. 3 Aug 1971.

Available from the Commission of European Communities, Luxembourg.

In a "slow-growing" process, in which U_3O_8 powder is added to seeds consisting of U_3O_8 in a gyrating tray, particles of uniform size are produced. Instead of singering the particles and then reducing them to UO_2, the particles according to the invention are directly subjected to a reduction sintering process at about 1400°C and then coated with fission product-retaining layers without further heat treatment at higher temperatures. (EU)

8225 UO_2F_2 AS STARTING MATERIAL FOR UO_2 KERNEL MANUFACTURE. Price, M. S. T. (to United Kingdom Atomic Energy Authority). British Patent 36,730/71. 4 Aug 1971.

Available from the Commission of European Communities, Luxembourg.

Coating fuel particles are produced by the use—as a starting material—of artefacts, i.e., spheroids consisting of UO_2F_2, which in a steam/hydrogen atmosphere at about 700°C are transformed into UO_2 particles. These particles have a uniform porosity and can be coated in known manner to form coated-particle nuclear fuel. (EU)

8226 FLUIDIZATION CHAMBER FOR COATING MATERIAL PARTICLES. Flamm, H. J. (to EURATOM). Dutch Patent 7,114,711. 26 Oct 1971. (In Dutch).

Available from the Commission of European Communities, Luxembourg.

Fluidized-bed coating chambers, as applied to coating of nuclear fuel particles, usually consist of a conical lower section extending into an upper cylindrical part. From the point of heat transfer a trough-type coating chamber is proposed, comprising two side walls, two transverse walls, and a base. The four walls have their lower edges resting in a groove at the base and are held by a closure block. By replacing the loose side walls by larger or smaller ones, different quantities of material particles may be treated by means of the same oven unit. (EU)

8227 FURNACE FOR COATING PARTICLES AT HIGH TEMPERATURE. Flamm, H. J. (to EURATOM). Dutch Patent 70,17280. 27 Nov 1970. (In Dutch).

Available from the Commission of European Communities, Luxembourg.

A furnace for the batch-wise coating of particles in a heated fluidized bed, comprises a graphite reaction chamber and a graphite heater that can be heated by a direct passage of current and that is disposed concentrically around the reaction chamber. The reaction chamber is electrically connected to a first conducting lead via a first electrically conducting, coolable block and is also electrically connected by a sliding contact to the graphite heater, which is electrically connected to a second conducting lead via a second, electrically conducting, coolable block, the first and second blocks being insulated from one another. This furnace has a very good thermal efficiency. (EU)

8228 COATED PARTICLE OXIDE FUEL FOR NUCLEAR REACTORS: ADDITION OF MOLYBDENUM TO CERIA-DOPED FUEL. Burnett, R. C. (to Dragon). British Patent 57,853/71. 13 Dec 1971.

Available from the Commission of European Communities, Luxembourg.

A nuclear fuel particle is described comprising a kernel composed at least in part of a nuclear fuel oxide and a multivalency buffer material such as ceric oxide in close adjacency with the fuel oxide also includes a substance such as molybdenum, which reduces the affinity of the buffer for atmospheric oxygen. (EU)

8229 STUDY OF THE ELECTRIC QUADRUPOLE INTERACTION (E.Q.I.) IN $(Pb_{0.925}-Ba_{0.075})ZrO_3$ BY PERTURBED ANGULAR CORRELATIONS. Saitovitch, H. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Fechner, J. B. Notas Fis., Cent. Brasil. Pesqui. Fis.; 19: No. 14, 339-358(1973).

The EQI in polycrystalline $(Pb_{0.925}-Ba_{0.075})ZrO_3$ was investigated in the temperature range 22°C → 240°C → 22°C by TDPAC measurement. For the application of this technique $(Pb_{0.925}-Ba_{0.075})ZrO_3$ was doped with small amounts of radioactive ^{181}Hf. According to crystal structure studies this compound exhibits phase transitions at 175°C (antiferroelectric → ferroelectric) and at ~250°C (ferroelectric → paraelectric); it exhibits too a large temperature hysteresis at the lower transition. It was found that the electric field gradient (EFG) exhibits a sharp discontinuity at approximately 170°C, corresponding to the first phase transition, and slightly sharp discontinuity at approximately 200°C, corresponding to the second phase transition. In the cubic phase, a remaining EFG is observed, probably caused by lattice imperfections in the source. No variation of the EFG following the hysteresis loop was found. The measured EFG and the measured asymmetry coefficient of the EFG were compared with the result of a lattice-sum calculation. This is the first study of the variation of the cell parameters of $(Pb_{0.925}-Ba_{0.075})ZrO_3$, and a criterion of atomic displacements based on the atomic displacements that occur in $PbZrO_3$ was established. (auth)

8230 STRUCTURAL ASPECTS OF THE METAL–INSULATOR TRANSITIONS IN Cr^{-} AND Nb-DOPED VO_2. Rao, C. N. R.; Rao, G. R. (Indian Inst. of Tech., Kanpur). Indian J. Pure Appl. Phys.; 11: No. 5, 368-370(May 1973).

$V_{(1-x)}Cr_xO_2$ with x = 0.008 and $V_{(1-x)}Nb_xO_2$ with x = 0.05 transform to the rutile phase through an intermediate orthorhombic phase, while $V_{0.95}Cr_{0.05}O_2$ is orthorhombic at room temperature, indicating the importance of antiferroelectric displacements of V^{4+} ions in the metal–insulator transitions. (auth)

8231 X-RAY STUDY OF THE THERMAL EXPANSION OF NEPTUNIUM DIOXIDE. Sadakov, L. V.; Kapshukov, I. I.; Solntsev, V. M. At. Energ. (USSR); 35: No. 2, 128(Aug 1973). (In Russian).

High-temperature x-ray studies showed that, from room temperature to 700°C, the coefficient expansion of the NpO_2 crystalline lattice is constant at 9.5×10^{-6} per degree. With increasing temperature above 700°C, the coefficient increases, reaching 11×10^{-6} at 1000°C. These data are consistent with published values for other actinide dioxides. (TTT)

8232 LATTICE DISORDER IN ALUMINA SINGLE CRYSTALS PRODUCED BY ION BOMBARDMENT. Naguib, H. M.; Singleton, J. F.; Grant, W. A.; Carter, G. (Univ. of Salford, Eng.). J. Mater. Sci.; 8: No. 11, 1633-1640(Nov 1973).

The effect of 40-keV Kr ion bombardment of Al_2O_3 single crystals was investigated using a Rutherford backscattering–channelling (RBC) technique. Curves of lattice disorder were found to be sigmoidal, the disorder increasing slowly up to a fluence of 1×10^{15} ions cm^{-2} and then accelerating to a saturation level at $\sim 1 \times 10^{16}$ ions cm^{-2}. These doses are about 100 times higher than comparable values found for elemental and III–V semiconductor compounds. The number of displaced atoms per incident ion estimated for an ion dose of 3×10^{14} ions cm^{-2} was found to be less than that calculated using Sigmund's equation. This difference is discussed in terms of defect recombination and re-ordering during bombard-

ment. Measurements taken from the RBC random spectra before and after each bombardment have indicated that the stoichiometry of the alumina crystals did not alter even at the highest bombardment fluences used. (auth)

8233 REACTION OF THORIUM MONONITRIDE WITH GRAPHITE. Ozaki, S.; Ono, Y.; Kanno, M. (Tokyo Univ.). J. Nucl. Sci. Technol. (Tokyo); 10: No. 6, 374-378(Jun 1973).

An experimental study was made on the carbothermic reaction of ThN with graphite in the form of a loose powder mixture in vacuo. The effects of reaction temperature and particle size were examined. The graphite and ThN powders were mixed in proportions representing molecular ratios of about unity. Three kinds of samples of different particle sizes were utilized. Gravimetric measurements on the reaction were made isothermally in the temperature range of 1,420° ~ 1,630°C. For these samples of different particle sizes, the reaction kinetics were represented in common by first-order plots for the early part of the reaction. The apparent activation energies were about 60 kcal/mol for the three samples. X-ray examination revealed the reaction products to be mainly ThC_xN_{1-x} with some ThC_2 and/or $ThC_{x'}N_{1-x'}$ in the case of the fine- and medium-particle-size samples. As for the coarse powder, the products were identified to be ThC_xN_{1-x} and $ThC_{x'}N_{1-x'}$ without any ThC_2. As the reaction proceeded, each carbonitride took up more carbon and at the same time the carbon-rich carbonitride increased in quantity and the other decreased. (auth)

8234 ANNEALING BEHAVIOR OF NEUTRON-IRRADIATED β-SiC. Suzuki, H.; Iseki, T.; Ito, M. (Tokyo Inst. of Tech.). J. Nucl. Mater.; 48: No. 3, 247-252(Oct 1973).

The post-irradiation annealing behavior of β-SiC for use as a monitor of irradiation temperature is discussed. Powder and rods of polycrystalline β-SiC were irradiated to 1.5×10^{17} to 5.0×10^{19} n/cm^2 (E > 0.18 MeV) at temperatures between 290 and 500°C. The estimated temperatures deduced from the changes in lattice constant and specific electric resistivity during progressive annealing, and from thermal expansion measurement by high-temperature x-ray diffraction agreed with values determined by means of a thermocouple. Thermal expansion measurement in a conventional dilatometer resulted in an overestimate of the irradiation temperature, and further improvement of this method is required for experimental application. (5 figures) (auth)

8235 URANIUM SELF-DIFFUSION IN STOICHIOMETRIC URANIUM MONOCARBIDE. Sarian, S.; Dalton, J. T. (United Kingdom Atomic Energy Research Establishment, Harwell, Eng.). J. Nucl. Mater.; 48: No. 3, 351-359(Oct 1973).

Uranium-233 self-diffusion was studied in stoichiometric uranium monocarbide; the diffusion coefficients can be represented by the expression $D = (2.58 \times 10^3 \exp(-157{,}000 \pm 5{,}000/RT)$ cm^2/s in the temperature range from 1900 to 2260°C. Self-diffusion of uranium and carbon in stoichiometric and hypostoichiometric uranium carbides occurs by a vacancy mechanism. It is shown that the kinetics and mechanism are similar to those for self-diffusion in the group IVb and Vb transition element monocarbides; for these B1 (fcc) type carbides in general, the activation energy for diffusion is empirically correlated to the congruent melting temperature: for carbon $\Delta H_m^C \simeq 31\ T_m$ and for the metal, $(\Delta H)^I + \Delta H_m^M) \simeq 54\ T_m$. In addition, the activation entropies correlate well to the temperature derivative of the shear modulus; this behavior is consistent with the familiar Zener model. Microstructural effects have probably been the principal underlying cause of the preponderant discordance in the results of other investigators. (5 figures, 39 references) (auth)

8236 OBSERVATION OF LATTICE AND GRAIN-BOUNDARY DISLOCATIONS IN UO_2 DEFORMED AT HIGH TEMPERATURES. Yust, C. S. (Oak Ridge National Lab., TN); Roberts, J. T. A. J. Nucl. Mater.; 48: No. 3, 317-329(Oct 1973).

The microstructure of a series of deformed, polycrystalline UO_2 specimens was studied by transmission electron microscopy. The lattice and grain boundary dislocation structures observed correlate with three temperature regimes of deformation. At temperatures below the brittle-to-ductile transition temperature, T_c, the specimen is completely brittle and all grains are essentially free of dislocations. The grain boundary structures observed in these brittle specimens are very regular in appearance. In the temperature range between the high-temperature transition, T_t, and T_c, where small degrees of plastic deformation are recorded prior to fracture, the first evidence of dislocation activity within the grains is noted, while the boundary structures remain regular. Above T_t, appreciable plasticity occurs prior to fracture and extensive dislocation network formation occurs in the grains of the polycrystal. In addition, the structures in the grain boundaries become irregular in appearance. A qualitative discussion of the deformation process in polycrystalline UO_2 is derived from the observations of this study. (14 figures) (auth)

8237 GROWTH OF SINGLE CRYSTALS OF ReO_3 BY CHEMICAL VAPOR TRANSPORT. Pearsall, T. (Cornell Univ.; Ithaca, NY). J. Cryst. Growth; 20: No. 3, 192-194(Oct 1973).

Growth of single crystals of ReO_3 using chemical vapor transport is reported. Hydrogen chloride and iodine were used as transporting agents. It was found that crystal growth can occur at temperatures far in excess of the temperature at which ReO_3 decomposes in vacuo, and a considerable increase in the growth rate is hereby achieved. (auth)

8238 ELECTRONIC STRUCTURE OF THE METALLIC TUNGSTEN BRONZES $La_{x-y}Gd_yWO_3$ (ESR MEASUREMENTS). Sperlich, G.; Jansen, K.; Bang, G. (Technische Hochschule, Darmstadt, Ger.). Phys. Lett.; 45A: No. 5, 423-425(22 Oct 1973).

ESR and magnetic susceptibility measurements on the metallic bronze $La_{x-y}Gd_yWO_3$ ($x = 0.10, 0.15$; $y \leq x$) prove that the $6s^25d^1$ orbitals of the rare earth (RE) ions do not contribute to the conduction band of the WO_3 complex. The RE ions are completely decoupled from it; crystal field effects, therefore, are observable. (auth)

8239 MANUFACTURE OF FUEL FOR NUCLEAR REACTORS. Hrovat, M. F.; Gough, J. R. C.; Price, M. S. T. (to Dragon). British Patent 54,278/70. 13 Nov 1970.

Available from the Commission of European Communities, Luxembourg.

A mixture of fission-product-retaining fuel particles, a polymerizable resin, and granular matrix material are pressed in a die cavity under substantially isothermal conditions at a temperature at which the resin melts but does not suffer a change in structure and, together with the matrix material, exhibits a plasticity that allows compaction throughout the die cavity. Sufficiently isothermal temperature conditions may be achieved by heating the die, die plungers, and die contents in an oven at a slow rate of up to about 4°C per minute. It is advantageous to employ a polymerizable resin which is chemically unchanged during the heating and pressing stage. A phenol formaldehyde resin having a low orthocomponent is suitable, the formaldehyde/phenol ratio of which is less than one but nevertheless close to unity. (EU)

8240 THERMODYNAMIC CHARACTERIZATION OF THE U_3O_{8-z} PHASE. Ackermann, R. J.; Chang, A. T. (Argonne National Lab., IL). J. Chem. Thermodyn.; 5: No. 6, 873-890 (Nov 1973).

A thermodynamic investigation of the U_3O_{8-z} phase, mole ratio n(O)/n(U) from 2.60 to 2.67, at 840 to 1450°K via measured partial pressures of O_2, $p(O_2)$ ranging from 10^{-6} to 1 atm, was obtained by a thermogravimetric gas-equilibration method. Values of the chemical potential of O_2 and the standard Gibbs free energy of formation of the U_3O_{8-z} phase were calculated for various compositions and temperatures. The nature of the defect structure of the sub-stoichiometric U_3O_8 at low temperature and/or high $p(O_2)$ appears to be randomly distributed doubly charged oxygen vacancies. However, at high temperature and/or low $p(O_2)$, i.e. greater departure from stoichiometry, a more complex defect structure appears to occur. The z-dependence of the standard Gibbs free energy of formation of solid U_3O_{8-z} was calculated, and hence, a more accurate evaluation of the standard Gibbs free energy of formation of the gaseous UO_3 was made via the reaction: $(\frac{1}{3})U_3O_{8-z}(s) + [(1+z)/6]O_2(g) = UO_3(g)$. (auth)

8241 DIES FOR USE WITH COMPACTING PRESSES. Sturge, D. W. J. (to United Kingdom Atomic Energy Authority). British Patent 1,328,499. 30 Aug 1973. 3p.

Reference is made to dies for compacting loose granular material into coherent articles, and particularly to dies for use in compacting batches of coated-particle nuclear fuel, the particles being overcoated with a deformable layer of matrix forming material, usually C powder, to fill the spaces between them. The compacts must be of substantially uniform density and for this purpose the die must allow the contents to be subjected to pressure in two opposed senses and hence be double acting. The die has an upright cavity of annular form between inner and outer cylindrical members that form its side walls, with upper and lower plungers co-operating with the inner and outer members forming the end walls. The latter inner cylindrical member is carried by the lower plunger so as to remain stationary relative to the lower plunger, and means are provided for displacing the outer cylindrical member in unison with the upper plunger so as to cause a reduction in cavity volume. Resilient means are provided for resisting the reduction in volume, together with stop means for arresting the displacement. Several alternative constructions are described. (UK)

8242 METHODS OF MAKING NUCLEAR FUEL COMPACTS: BUILDING UP A FUEL COMPACT BY ALTERNATE PLACING OF

MATRIX MATERIAL AND COATED PARTICLES. Cox, G. T. (to Dragon). British Patent 61,431/70. 20 Dec 1970.
Available from the Commission of European Communities, Luxembourg.
A method of forming a nuclear fuel compact is described, comprising fission-product-retaining fuel in the form of coated spheroids and a filler material and incorporating a polymerizable binder. The method incorporates formation of a green compact by depositing the filler material and the binder in a mold in successive layers, inserting into each layer a monolayer of fission-product-retaining spheroids before depositing the next adjacent layer of filler material and, having completed the compact, polymerizing the binder to form the green compact into a coherent body. (EU)

8243 COATED-PARTICLE FUEL FOR NUCLEAR REACTORS. Steemers, T. C. (to Dragon). British Patent 6907/71. 15 Mar 1971.
Available from the Commission of European Communities, Luxembourg.
A particle of fission-product-retaining nuclear fuel comprising a kernel of fissile nuclear fuel, and bearing one or more coatings of fission-product-retaining material reactive with oxygen, is described. The particle incorporates in close adjacency with the kernel material, an oxide of cerium, at least partially in a lower valency state which acts as a buffer for oxygen in the system. (EU)

8244 FISSION PRODUCTS RETAINING NUCLEAR REACTOR FUEL: OXYGEN GETTERING IN UO_2 PARTICLES USING AS ADDITIVE SINGLE-VALENCY RARE EARTH OXIDES. Steemers, T. (to Dragon). British Patent 7,752/72. 18 Feb 1972.
Available from the Commission of European Communities, Luxembourg.
As applied to a UO_2 fuel, a nuclear fuel particle according to the invention may comprise a central seed of lanthanum oxide enveloped in UO_2-powder so as to form a substantially spherical kernel. The kernel may then be coated by one or more layers of fission-product-retaining material comprising layers of pyrocarbon and preferably one layer of silicon carbide. The lanthanum oxide acts as an oxygen getter when oxygen is liberated from fissioned uranium. (EU)

8245 METHOD FOR PRODUCING CRYSTAL PLATE OF GADOLINIUM MOLYBDATE. Yumoto, H. (to Hitachi, Ltd.). US Patent 3,775,066. 24 Nov 1973. Priority Date 30 Sep 1970, Japan. 6p.
A method is described for producing single-crystal plate of gadolinium molybdate. A crystal plate of a specified orientation of gadolinium molybdate is formed at the surface of a melt of gadolinium molybdate while effecting in the melt a temperature gradient. The melt surface is at a lower temperature than that of the inner portion, and the whole melt is cooled from 1200 to 1100°C at a cooling rate of 30 to 170°C/min to obtain single crystals of a specified orientation of gadolinium molybdate. (Official Gazette)

8246 PRODUCTION OF NUCLEAR FUEL PARTICLES COATED WITH SILICON CARBIDE. Ford, L. H.; Davidge, R W.; Evans, A. G. (to United Kingdom Atomic Energy Authority). US Patent 3,776,759. 4 Dec 1973. Priority date 8 Jan 1971, United Kingdom of Great Britain and Northern Ireland. 4p.
In the production of nuclear fuel particles, carbon-coated nuclear fuel kernels are coated with silicon carbide. Deposition of the silicon carbide at a low rate increases the strength of the silicon carbide coating. It is necessary only for the outer layers to be deposited at the low rate. The temperature of deposition, the nature of the substrate, and the composition of fluidizing gas may be relevant factors. (Official Gazette)

8247 NUCLEAR FUEL. Williams, N. R.; Lloyd, H. (to United Kingdom Atomic Energy Authority). US Patent 3,773,867. 20 Nov 1973. Priority date 6 Aug 1969, United Kingdom of Great Britain and Northern Ireland. 4p.
A method is described of forming a nuclear fuel body comprising a plurality of kernels of nuclear fuel material coated with fission-product-retaining material in a suitable matrix. The method comprises the steps of pressing the coated kernels which are overcoated with a layer of matrix material and a binder to form a compacted artefact while at the same time subjecting the kernels and matrix material to vibrations. The resulting compacted artefact is then cured and outgassed. (Official Gazette)

8248 METHOD FOR SINTERING VERY PURE YTTRIA COMPACTS TO TRANSPARENCY. Muta, A.; Tsukuda, Y. (to Hitachi, Ltd.). US Patent 3,764,643. 9 Oct 1973. Priority Date 21 Nov 1969, Japan. 6p.
Finely divided yttria having a purity of at least 99.99% is pressed into compacts, sintered in dry hydrogen or a partial vacuum to temperatures in the range of 2150 to 2330°C, and refired in wet hydrogen at a temperature of from 1950 to 2300°C to reoxidize any yttria that was reduced to yttrium during sintering. A dense body transparent to visible light is produced. If a trahsparent article is not desired, the purity can be reduced. (Official Gazette)

8249 USE OF ALUMINA AS A SINTERING AID IN MANUFACTURE OF HOT PRESSED BERYLLIA. Greenspan, J. (to Secretary of the Army). US Patent 3,763,295. 2 Oct 1973. Filed Date 5 Apr 1971. 4p.
A method is described for the fabrication of high-strength beryllia–alumina alloys comprising the steps of preparing a raw powder mix of beryllium oxide containing 5 to 20% aluminum oxide by weight, die–ram pressing in a partial vacuum at a temperature of about 1400°C under a pressure of about 4000 psi. A sintering aid mixture of alumina, magnesia, and silica is also disclosed. (Official Gazette)

Metals and Alloys

Refer also to abstracts 7650, 7661, 7670, 9378, and 9659.

8250 (AERE-PR/Met-7) METALLURGY DIVISION HIGHLIGHTS PROGRESS REPORT, JANUARY 1972–DECEMBER 1972. Hancock, N. H. (comp.). (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1973. 58p. Dep. NTIS (U. S. Sales Only) $5.00.
The report covers four topics, entitled: the fiber composite development laboratory; the development of sodium bonded mixed carbide fuel pins; computer simulation of electron microscope images from crystal defects; developments in the electron probe microanalysis and the scanning electron microscopy of radioactive materials. The last three topics were in NSA scope, and separate abstracts were prepared for them. (UK)
For abstracts of individual sections see: 8184, 8272, and 8340.

8251 (JINR-P6-7400) FORMATION OF CYCLOTRON TARGETS FROM TRANSPLUTONIUM AND RARE-EARTH ELEMENTS BY ELECTRODEPOSITION FROM ISOBUTYL ALCOHOL. Korotkin, Yu. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.
The process is studied of electrodeposition of transplutonium and rare-earth elements from isobutyl alcohol. The conditions are found for formation of thick (up to 2 mg/cm^2) cyclotron targets from these elements stable when bombarding by accelerated multiply charged Ne and O ions. It is shown that small impurities of ethyl alcohol (1 to 5%) suppress the process of gas generation in electrodeposition of transplutonium and rare-earth elements. (auth)

8252 MICROSTRUCTURE AND DESIGN OF ALLOYS. Volume 1. Proceedings of the Third International Conference on the Strength of Metals and Alloys, Cambridge, England, August 20–25, 1973. London; Iron and Steel Institute (1973). 629p. £12.50.
This volume includes 132 papers arranged into sessions dealing with: strengthening mechanisms, strengthening in commercial materials, interdependence of strength and ductility at low temperatures, creep strength and ductility, composites, particle hardening, formability and workability, fatigue, environmental influences in service performance, future materials design, and solution hardening. Separate abstracts were prepared for 14 of the papers; one of the remainder was previously abstracted as NSA 28: 13231. (DLC)
For abstracts of individual papers see: 8282–8294 and 8355.

Corrosion and Erosion

Refer also to abstracts 8367 and 9214.

8253 (AECL-4653) IMPACT FRETTING OF HEAT EXCHANGER TUBES. Ko, P. L. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1973. 33p. Dep. NTIS (U. S. Sales Only) $3.75. AECL $1.00.
Impact fretting of heat-exchanger tube and baffle materials was studied in air and in demineralized water. The excitation frequency, amplitude, ratio of major axis (Y_{max}) to minor axis (X_{max}) of an elliptic orbit (X–Y plot) of the unrestrained tube movement, clearance between tube, and baffle and number of

cycles were varied. The ratio of Y_{max} to X_{max} governs the amount of normal impact and sliding motion. Electrical-contact resistances between the impacting materials were monitored and the signals correlated with weight losses. The results show that the amount of wear per million cycles increases exponentially with excitation frequency, and increases with amplitude and diametral clearance. The amount of wear also varies with the ratio of Y_{max} to X_{max} ($Y \geq X$) of the excitation amplitude; a peak is reached when the ratio is between 2 and 3. In the dry cases, oxidized wear debris was found on the surfaces; the wear rate decreased with time during the early stages of the test and then became almost constant. In the wet cases, the worn surfaces were shiny in appearance, and the wear rate remained almost constant throughout the tests. (auth)

8254 (CONF-731101-31) FUSED-SALT CORROSION AND ITS PREVENTION IN FUSION REACTORS. Cantor, S.; Grimes, W. R. (Oak Ridge National Lab., Tenn. (USA)). 1973. 19p. Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Fused salts flowing at high velocity across strong magnetic fields can experience intolerably large induced emfs; measurements of emf's induced in aqueous solutions with electrical conductivities less than that of Li_2BeF_4 were found to obey Faraday's law of electromagnetic induction even under highly turbulent flow conditions. Induced emfs, of course, are absent when the flow is parallel to the magnetic field lines and should be minimized by such flow conditions wherever possible. In regions where molten salt enters and leaves the blanket structure, induced emfs can be minimized by dividing the flow among many small parallel pipes, by use of ferromagnetic pipe sections and, perhaps, by maintaining a frozen layer of salt on internal surfaces of pipe. Transmutations of Li, Be, and F in the blanket yield oxidants capable of corroding structural metals. Such corrosion can presumably be avoided by adding a reductant of suitable redox potential to the blanket. For example, low concentration of dissolved CeF_3 or slurried Be should be capable of reacting with the oxidants and minimizing their deleterious effect. Leaks of steam or air through faulty pipes or heat exchangers would lead to markedly enhanced corrosion with most or all metals of interest, and leaks of alkali metals into Li_2BeF_4 would cause reduction of BeF_2 to Be. Such inadvertant mixing would prove troublesome, but it seems less troublesome than similar leakage of steam or air into liquid alkali metals. (auth)

8255 (CONF-731101-37) CALCULATIONS ON THE COMPATIBILITY OF REFRACTORY METALS IN A TRITIUM ENVIRONMENT AND COLD-TRAPPING METHOD FOR TRITIUM REMOVAL FROM A LITHIUM BLANKET. Natesan, K.; Smith, D. L. (Argonne National Lab., Ill. (USA)). 1973. 40p. Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Thermodynamic calculations were made on the distribution of hydrogen and tritium between various refractory metals and liquid lithium as a function of temperature. The limiting tritium pressures that can be attained by cold trapping of secondary liquid metals such as Na, K, and NaK were calculated. In the absence of tritium breeding, these pressures are 2.5×10^{-5}, 2×10^{-7} and 1.2×10^{-10} torr for Na, K, and NaK, respectively, and these correspond to tritium concentrations in lithium of 45, 4, and <1 ppM, respectively, at 700°C. For a thermonuclear reactor of 1000 MW(t) thermal power with a tritium breeding rate of 150 g/day, a tritium recovery system that incorporates a separate lithium purification loop with niobium as the permeable membrane, NaK as the secondary heat transport fluid and with tungsten cladding on the IHX tubes seems to yield tritium pressures of $\sim 10^{-3}$ torr or less in the secondary system. This leads to tritium release rate of $\sim 10^{-4}$ g/hr to the steam system for a steam generator clad with tungsten and operating at ~600°C. This corresponds to activity release rate of ~300 Ci/yr. (17 figures, 61 references) (auth)

8256 (ORNL-TM-4286) ALLOY COMPATIBILITY WITH $LiF-BeF_2$ SALTS CONTAINING ThF_4 AND UF_4. Koger, J. W. (Oak Ridge National Lab., Tenn. (USA)). Dec 1972. Contract W-7405-eng-26. 49p. Dep. NTIS $4.50.

Various compatibility tests between $LiF-BeF_2$-based salts and Hastelloy N and certain steels were conducted in thermal convection loops. Temperature gradient mass transfer, as noted by weight losses in the hot leg and weight gains in the cold leg, was evidenced in all tests. The weight changes of corrosion specimens increased with increasing temperature and time. From an operational standpoint, some difficulty was encountered in melting $LiF-BeF_2-ThF_4$ mixtures without mechanically failing the loop. The difficulty stemmed from the high melting point of the salts and the high melting point of certain phases in the salts. All the salts tested were compatible with Hastelloy N. Bismuth in contact with a fuel salt had no effect on mass transfer in a Hastelloy N loop. It was established that electrochemical methods to determine the oxidation potential of molten fluoride salts could be used to predict the corrosion behavior of a thermal convection loop. The values obtained by the electrochemical methods correlated well with specimen weight change data. It was shown that tellurium (as plated on Hastelloy N specimens) does mass transfer in a molten fluoride salt system and that an equilibrium between tellurium in the salt and tellurium on the alloy can be established. A type 304L stainless exposed to a fuel salt for 9.5 years in a type 304L stainless steel loop showed a maximum uniform corrosion rate of 0.86 mil/year. Voids extended 10 mils into the matrix. Chromium depletion was found. The corrosion resistance of maraging steel (12% Ni–5% Cr–3% Mo–bal Fe) at 662°C was better than type 304L stainless but worse than Hastelloy N under equivalent conditions. The uniform corrosion rate was 0.55 mil/year. Subsurface voids were seen in the microstructure of the specimens after 5700 h, and microprobe analysis disclosed depletion of chromium and iron. Type 316 stainless steel exposed to a fuel salt in a type 316 stainless steel loop showed a maximum uniform corrosion rate of 1 mil/year for 4298 h. Mass transfer of chromium and iron did occur in the system. For selected nickel- and iron-base alloys a direct correlation was found between corrosion resistance in a molten fluoride salt and the chromium and iron content of an alloy. The more chromium and iron in the alloy, the less the corrosion resistance. (auth)

8257 (RCN-194) LONG-TERM CORROSION OF CARBON STEEL, CORTEN, CROLOY, YOLOY, MONEL-400, INCONEL-600, Zr–2.5 wt % Nb, ZIRCALOY-4, AND VALLOY IN RECIRCULATING WATER AT 345°C. van der Linde, A. (Stichting Reactor Centrum Nederland, Petten (Netherlands)). Oct 1973. 88p. Dep. NTIS (U. S. Sales Only) $6.50.

Specimens have been corrosion tested at 345°C for at least 520 days in recirculating, 1 m/sec, water. The water chemistry conditions at 25°C were pH 9-10 with 0.4 to 10 ppM NH_3, 0.02 to 0.3 ppM oxygen, and 0.3 to 1.4 ppM hydrogen. After each test run for 40 to 90 days of the pressurized water loop, all specimens were dried, weighed, and photographed. Postcorrosion specimen investigations involved metallographic and microprobe investigations on cross sections, x-ray diffraction analyses of the oxide film, oxide surface photography with a scanning electron microscope, deoxidation of steel specimens in high-temperature hydrogen, and chemical hydrogen analyses. The most important results were: Zr–2.5% Nb in the 850°C annealed, water-quenched, 15%-cold-worked, 24-hours-aged at 500°C and pickled condition had the smallest corrosion rates of the 980 days-exposed Zr alloys, namely + 0.12 mg $O/dm^2 \cdot$ day and + 2.7 μg $H/dm^2 \cdot$ day. For fully annealed Zircaloy-4, these rates were + 0.32 mg $O/dm^4 \cdot$ day and + 3.6 μg $H/dm^2 \cdot$ day. Monel-400, exposed 980 days in the unstressed condition, suffered suboxide scale grain-boundary attack, at a penetration rate of about 0.1 μm/day. Inconel-600, exposed 980 days in the unstressed condition, showed only very slightly intergranular attack so that Inconel-600 is the favorable boiler tubing material in ammoniated, oxygen-containing, high-temperature water. The corrosion of iron-base alloys in high-temperature water is governed by the solubilities of the oxides. The solubilities are largely influenced by the water chemistry conditions such as pH, P_{O_2}, and P_{H_2} at the operating temperature. The measured overall linear corrosion rates, expressed in mg corroded metal/$dm^2 \cdot$ month at exposure times longer than 250 days were 99 for carbon steel, 59 for Corten, 44 for Croloy, and 40 for Yoloy. The standard deviations were 5% for carbon steel and Corten and 3% for Croloy and Yoloy. The percentage of corroded metal released as magnetite to the recirculating water was 90 for carbon steel, 77 for Corten, 75 for Croloy, and 68 for Yoloy. Crevice attack and pitting of the investigated iron- and nickel-base alloys were not serious. The maximum observed penetration was only 55 μm, after 939 days exposure, in a crevice of a carbon steel specimen. (14 tables, 32 figures) (auth)

8258 CORROSION-RESISTANT ZIRCONIUM ALLOYS. Givord, J. P.; Demars, H. (to Ugine-Kuhlmann). French Patent 2,129,157. 17 Mar 1971. 5p. (In French).

A zirconium-based alloy containing 0.40 to 1.20% (by weight) vanadium and 0.05 to 1% (by weight) copper is presented. The most important applications of this alloy concern nuclear reactor cores: structural elements, calander tubes, channel tubes, and tubes for the cladding of fuel elements, these tubes being in contact with water, steam–water mixtures, or superheated steam. The alloy remains free from corrosion during very long periods of exposure to superheated steam up to 500°C and can support temperatures in excess of 550°C for shorter periods of time.

It is always more corrosion-resistant in steam at 400°C than the usual zircaloy 2 and 4 alloys. (FR)

8259 THERMAL AND MECHANICAL EFFECTS ON THE CORROSION BEHAVIOR OF Ti–6Al–4V ALLOY. Dull, D. L.; Raymond, L. (Aerospace Corp., Los Angeles). J. Electrochem. Soc.; 120: No. 12, 1632-1637(Dec 1973).

Anodic and cathodic polarization behavior of Ti–6Al–4V alloy were determined by potentiostatic and galvanostatic techniques in deaerated 1, 5, and 10N sulfuric acid solutions. In the active region, metallurgical processing, which included cold rolling and thermal treatment, had no effect on the corrosion behavior. It is suggested that a titanium hydride film exists on the titanium alloy surface. In the passive region, plastic deformation, due to cold rolling, did increase the passive current density; whereas crystallographic texturing did not have an effect. The introduction of an α-phase due to thermal treatment produced an additional peak in the passive region. (auth)

8260 INTERACTIONS OF OXYGEN WITH TANTALUM AND NIOBIUM AT HIGH TEMPERATURES. Jupille, J.; Pacia, N.; Weber, B. (CNRS, Villers-les-Nancy, France). Vide; 28: No. 164, 51-53(Mar 1973). (In French).

The model developed to represent interactions between oxygen (at low pressure) and high-temperature transition metals enabled experimental results obtained under steady-state conditions to be verified for platinum, rhenium, tungsten, molybdenum, tantalum, and niobium. This model assumes that the adsorption of oxygen is the only reaction that can occur between the gas phase and the surface. The results obtained for Ta and Nb undergoing isothermal desorption are presented. These two metals dissolve oxygen and, as a result, two regimes occur when the temperature and pressure vary. These steady-state and transient regime results are in agreement with the model envisaged and also with available thermodynamic data. (FR)

8261 SOLUBILITY OF TITANIUM ALLOYS AND ALLOYED STEELS IN LIQUID–METAL MEDIA OF INDIUM AND INDIUM–GALLIUM ALLOY. Zakharov, D. M.; Yatsenko, S. P.; Kiknadze, G. I.; Mel'nikova, L. V.; Dieva, E. N.; Danelyan, E. P. At. Energ. (USSR); 35: No. 3, 202-204(Sep 1973). (In Russian).

The corrosion rate of titanium alloys in liquid indium did not depend on passivation. In indium–gallium, the corrosion of non-passivated Ti alloy was the same as that of Ti metal, but passivation decreased the rate of Ti metal 25-fold while having no effect on the alloys. The quality of the oxide film on the alloy was not so good as that on the metal due to the complex composition. Reduction of titanium oxide by Al may destroy the oxide film. Solubility data of alloyed steel showed that, with increasing Cr content, the corrosion rate of steel decreased, possibly because of trivalent Cr in the surface film. The temperature interval of compatibility of alloyed steel in indium–gallium alloys is limited by the rate of processes that determine the formation of intermetallic compounds on the surface of construction materials. Stable types of steel are mentioned. (TTT)

8262 COMPARISON OF OXIDATION OF CAST AND SINTERED MAGNESIUM MATERIALS IN CO_2. Splichal, K.; Jurkech, L. (Inst. of Nuclear Research, Rez, Czech.). J. Nucl. Mater.; 48: No. 3, 277-286(Oct 1973).

Properties of oxide films formed on cast and sintered magnesium materials during oxidation in CO_2 at 793°K were examined. The compactness and the strength of oxide films were determined from film resistance to magnesium evaporation from the basic metal matrix by means of thermogravimetric measurements. The oxide films are thick, porous on Mg–MgO and Mg–MgF_2 materials and thin and protective on Magnox A12 and Mg 99.99. Incompact oxide films of Mg–Zr alloys facilitate the oxygen diffusion into the underlying layer of samples. The addition of dispersed beryllium into sintered materials results in the creation of two-component films with an inner protective BeO layer. The compact oxide films are resistant to evaporation of magnesium as well as to oxidation in CO_2. The incompact and less protective oxide films are characterized by the low temperature of the beginning of magnesium evaporation. The character of oxide films was influenced by the initial surface finishing and by the dispersed-phase morphology. (9 figures) (auth)

Preparation and Fabrication

8263 (N-73-28530) GAS TUNGSTEN ARC WELDING PROCEDURES FOR TANTALUM ALLOY T-111 (Ta–8W–2Hf) PLATE. Final Report, 1971–1972. Gold, R. E.; Kesterson, R. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). May 1973. Contract NAS3-15555. 86p. (NASA-CR-121198; WANL-M-FR-72-11). NTIS $6.50.

Methods of eliminating or reducing underbred cracking in multipass GTA welds in thick T-111 plate were studied. Single-V butt welds prepared using experimental filler metal compositions and standard weld procedures resulted in only moderate success in reducing underbred cracking. Subsequent procedural changes incorporating manual welding, slower weld speeds, and three or fewer fill passes resulted in crack-free single-V welds only when the filler metal was free of hafnium. The double-V joint design with successive fill passes on opposite sides of the joint produced excellent welds. The quality of each weld was determined metallographically since the cracking, when present, was very slight and undetectable using standard NDT techniques. Tensile and bend tests were performed on selected weldments. The inherent filler metal strength and the joint geometry determined the strength of the weldment. Hardness and electron-beam microprobe traverses were made on selected specimens with the result that significant filler metal–base metal dilution as well as hafnium segregation was detected. A tentative explanation of T-111 plate underbred cracking is presented based on the intrinsic effects of hafnium in the weldment. (auth)

8264 FEATURES OF ELECTRON-BEAM WELDING OF AN ALLOY OF THE Al–30Be–5Mg SYSTEM. Komarov, M. A.; Shiganov, I. N. Svar. Proizv.; No. 8, 22-24(Aug 1973). (In Russian).

The features of electron-beam welding were studied for ABM1 alloy (Al–30Be–5Mg) with deep melting in combination with the features of the alloy structure and composition where it was found that specific weld seam defects are caused in the form of a continuous cavity. Introduction of longitudinal beam oscillations with a frequency of 50 Hz and amplitude of 2 to 3 mm makes it possible to produce deep melting during electron-beam welding of the alloy and to remove the cavity formation. Electron-beam welding is accompanied by considerable vaporization of magnesium that leads to heterogeneity of chemical composition and hardness of metal in different sections of the weld joint. Redistribution of the beryllium constituent, depending on the thermal mode of welding, takes place in the transition zone. (JPRS)

8265 ELECTRON-BEAM WELDING OF NIOBIUM ALLOY AND STAINLESS STEEL THROUGH A VANADIUM LAYER. Veynik, V. A.; D'yachenko, V. V.; Chukanov, A. P. Svar. Proizv.; No. 5, 16-18(May 1973). (In Russian).

The interaction kinetics of a solid niobium alloy and liquid stainless steel through a vanadium layer was studied in a chamber at a residual pressure of 5×10^{-5}mm Hg. The vanadium was applied from a melt by the vacuum condensation method onto the niobium backing surface first prepared by a mixture of acids, 40% HF + 60% HNO_3. This ensures the satisfactory adhesion of the condensate to the surface. The specimen, consisting of stainless steel, vanadium layer, and niobium backing, was heated by an electron beam in order to approximate as closely as possible electron-beam welding conditions. The heating temperature of from 1400 to 1550°C was regulated either by focus or electron flux variation. The results show that vanadium should be used in the electron beam welding of VN-2AE vanadium alloy and Kh18N10T stainless steel 0.5-mm thick with only the steel being melted. The vanadium prevents the formation of an intermetallide layer in the fusion zone. In welding the indicated materials, a three-micron-thick vanadium layer makes it possible to expand the welding current by a factor of three in comparison to welding without vanadium. Barrier elements should be selected on the basis of graphs for mutual solubility of elements in the solid state. Such graphs should be constructed for the individual components of weldable alloys. (auth)

8266 BERYLLIUM IN TODAY'S SPACECRAFT. Switz, R. J. (Hughes Aircraft Co., El Segundo, CA). Metals.Eng. Quart.; 13: No. 4, 35-39(Nov 1973).

Uses of Be in spacecraft are reviewed. Be components are described including Agena panels Minuteman spacers, structural elements for communication satellites, cone skin assemblies, spin arm assemblies and de-spin platforms. Research on Be is discussed along with future uses. (JRD)

8267 DISPERSION-STRENGTHENED ZIRCONIUM PRODUCTS AND A PROCEDURE FOR FABRICATION OF SAME. Adolph, E.; Balling Jensen, J. C.; Hansen, N.; Kjoeller, J.; Hindle, E. D.; March, D. J.; Parsons, D. (to Atomenergikommissionen). Danish Patent 125,207. 15 Jan 1973. Filed date 21 Aug 1970. 11p. (In Danish).

A procedure is described for fabrication of dispersion-strengthened zirconium products containing fine metal oxide particles dispersed in a zirconium or zirconium alloy matrix. Zirconium or zirconium alloy in a hydrated, powered condition is mixed intimately with yttrium oxide, magnesium oxide, cerium oxide, or

beryllium oxide powder with a very small average particle size. The mixture is heated in vacuum until expulsion of hydrogen and simultaneous or subsequent sintering in a compressed condition at a temperature below 800°C and preferably below 750°C. (DE)

8268 METHOD OF ELECTROLYTICALLY REFINING ZIRCONIUM AND ZIRCONIUM ALLOYS. Wurm, J. G.; Heylen, P. R. (to EURATOM). Luxenburgian Patent 62,193. 7 Dec 1970. (In French).

Available from the Commission of European Communities, Luxembourg.

A method of electrolytically refining zirconium and zirconium alloys is described in which the anode consists of crude zirconium or its carbide and the electrolyte is a mixture of molten salts containing a zirconium compound. This method is made continuous by conveying the cathode continuously through the electrolyte. The method makes it possible to obtain zirconium with a constant purity, the method being fully automated, and alloys can be obtained if the cathode consists of or contains another metal than zirconium. (tr-auth)

8269 CRYSTAL GROWTH OF THE RARE EARTH METALS. McEwen, K. A.; Touborg, P. (Danmarks Tekniske Hoejskole, Lyngby). J. Phys., F (London); 3: No. 11, 1903-1909(Nov 1973).

Single crystals of the majority of the rare earth metals and alloys were grown by three techniques. The recrystallization method, first described by Nigh (J. Appl. Phys.; 34: 3323 (1963)), was simplified and used for Sm and the heavy rare earths Gd to Tm. The controlling parameters for this method are the purity of the material and the annealing temperature. Techniques to achieve optimum annealing and to reduce vapor loss are described. Pr, Nd, Eu, and PrNd crystals were produced by Czochralski pulling from the melt contained in a water-cooled crucible. Larger crystals of Pr and Nd may be made by float-zone melting. (auth)

8270 URANIUM ALLOY WITH INCREASED CORROSION RESISTANCE AND DECREASED SWELLING TENDENCY AND THE PROCEDURE FOR MANUFACTURE OF SUCH AN ALLOY. Wyatt, B. S. (to Atomic Energy of Canada Ltd.). Danish Patent 126,696. 13 Aug 1973. Filed date 15 Jun 1970. 4p. (In Danish).

A uranium-base alloy with increased corrosion resistance and decreased swelling tendency is described. The alloy contains from 3.5 to 3.7 wt % silicon and from 0.2 to 1.5 wt % aluminum. After casting, the alloy is subjected to a heat treatment corresponding to 800 to 850°C for 72-144 hours until practically the whole uranium–silicon phase has been converted into delta-U_3Si. (DE)

8271 DISPERSION-STRENGTHENED ZIRCONIUM PRODUCTS. Adolph, E.; Hansen, N.; Jensen, J. C. B.; Kjoller, J.; Parsons, P. D.; Hindle, E. D.; Marsh, D. J. (to Atomenergikommissionen). US Patent 3,775,823. 4 Dec 1973. Priority Date 21 Aug 1970, Denmark. 8p.

A method of producing dispersion-strengthened zirconium products containing fine particles of yttria, magnesia, cerium oxide, or beryllium oxide in a matrix of zirconium or a zirconium alloy is described. Preferred products are those containing dispersed fine particles of yttria. According to the method, hydrided zirconium or zirconium alloy in a pulverulent state is mixed with a fine powder of the oxide, and the mixture is then heated in vacuum to expel hydrogen. Simultaneously, or subsequently, the mixture—in a compressed condition—is sintered. This heating operation for expelling hydrogen and sintering the mixture is carried out at a temperature below 800°C, and preferably below 750°C. Preferred dispersion-strengthened zirconium products are characterized by having the metal oxide particles, of an average size not substantially exceeding 0.5μ and preferably between 0.01 and 0.5μ, dispersed in the said matrix having an average particle size not exceeding 5μ and preferably between 1 and 3μ. (Official Gazette)

Properties, Structure, and Phase Studies

Refer also to abstracts 7675, 8642, 9356, 9477–9480, 9482, 9650, 9673, 9688, and 9718.

8272 (AERE-PR/Met-7, pp 3.1-3.12) COMPUTER SIMULATION OF ELECTRON-MICROSCOPE IMAGES FROM CRYSTAL DEFECTS. Eyre, B. L. Sep 1973.

Metallurgy Division highlights progress report, January 1972–December 1972.

A computer program was developed for simulating two-dimensional electron-microscope diffraction contrast images from crystal defects imaged under two-beam and many-beam conditions. Displacement fields were determined for edge dislocation loops in an isotropic bcc crystal, and a very close match was achieved between theoretical and experimental images from loops in irradiated molybdenum. Thus, a sound basis was established for determining the detailed geometry of this type of defect. Displacement fields were determined for cavities in anisotropic crystals, and it is planned to study symmetry of images from such defects. It is also planned to study more completely the application of weak beam imaging to the analysis of small defects. The techniques can be applied to the study of any crystal defect for which the displacement field can be formulated, and it is of particular value in establishing the image–defect geometry relationship in cases where image symmetry is complex. (UK)

8273 (BNL-18315) X-RAY PHOTOEMISSION STUDIES OF RARE EARTH HARD MAGNETS. Cuthill, J. R.; McAlister, A. J.; Erickson, N. E.; Watson, R. E. (Brookhaven National Lab., Upton, N. Y. (USA)). 1973. 5p. (CONF-731104-9). Dep. NTIS $3.00.

From 19th conference on magnetism and magnetic materials; Boston, Massachusetts, USA (13 Nov 1973).

An attempt was made to probe the electronic properties of the RCo_5 compounds by x-ray photoelectron spectroscopy studies of $SmCo_5$ and $PrCo_5$ and to relate the results to the properties of the pure metals and to the picture developed to describe the magnetism of the compounds. Results indicate a valence band structure similar to that of Co metal; there is the suggestion that if there is charge flow it is off the rare-earth sites; there appears to be significant change in the 4f spectra from that of the pure rare-earth metals; and there is a suggestion of f–d hybridization. (auth)

8274 (CEA-CONF-2444) INTERGRANULAR MIGRATION AS A TOOL FOR THE STUDY OF THE STRUCTURE OF THE INTERIOR OF JOINTS. Martin, G.; Truchot, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Section de Recherches de Metallurgie Physique). 28 Jun 1973. 13p. (In French). (CONF-730727-1). Dep. NTIS (U. S. Sales Only) $3.00.

From international summer school on grain boundaries; Montreal, Canada (2 Jul 1973).

8275 (CONF-731101-38) RECENT FRACTURE TOUGHNESS AND FRACTURE INVESTIGATIONS OF THE USAEC HEAVY SECTION STEEL TECHNOLOGY (HSST) PROGRAM. Whitman, G. D. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 7p. Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Testing of 6-in.-thick sections of ASTM A508 and A533 steels is discussed. The static-fracture toughness of the as-fabricated plate steel has been demonstrated by lower-bound-toughness testing to exceed 400,000 psi $\sqrt{\text{in.}}$ from 200 to 550°F. Similar results are being sought for arrest toughness. Fracture toughness of appropriate steels and welds has been shown to exceed 200,000 psi $\sqrt{\text{in.}}$, well below the operating temperatures of water reactors (550°F) for fast-neutron radiation fluences as high as 8×10^{19} neutrons/cm^2, E > 1 MeV, irradiated near 550°F. Procedures have been developed for obtaining significantly high static and dynamic fracture toughness values from the test of small specimens, including specimens as small as Charpy specimen thickness compact tension specimens and precracked Charpy specimens. Methods for relating flaw size, loading conditions, and temperature (fracture toughness at a given temperature) have been developed and continue to be improved for predicting fracture conditions of pressure vessels. Vessels with large flaws (8 in. long by 3 in. deep in 6-in. walls) withstood three times design pressure before failure. It has been demonstrated that the potential of vessel fracture is extremely remote in the presence of large flaws even when subjected to significant doses of fast-neutron irradiation. (auth)

8276 (COO-1799-11) DIFFUSION AND PRECIPITATION OF INERT GASES IN METALS. Final Report. (Purdue Univ., Lafayette, Ind. (USA). School of Materials Engineering). 25 Sep 1973. Contract AT(11-1)-1799. 9p. Dep. NTIS $3.00.

The behavior of inert gases, particularly helium, in metals was studied in aluminum, copper, niobium and stainless steel. Emphasis was upon characterizing the state of helium in the metals and upon following the kinetics of precipitation and coalescence. Experimental techniques that are, in most cases, new to studies of inert gases in metals were employed. These include low-temperature specific heat, precision lattice parameter measurement, internal friction, computer simulation, and residual resistivity, in addition to confirmatory electron microscopy. The single most important finding is that bubble coalescence takes place at rates which are much slower than was previously supposed and that the slow coalescence fits a model in which the bubble mobility required for coalescence is rate-limited by nucleation of facets on the bubble surface. The further understanding and subsequent potential ability to control

rates of bubble and/or void coalescence will be important to the design of nuclear fuel and cladding materials. (auth)

8277 (HEDL-TME-73-73) COEFFICIENT OF FRICTION TESTS. Besel, L. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Sep 1973. Contract AT(45-1)-2170. 35p. AT.

Results of coefficient of friction tests performed at HEDL to evaluate load pad coating materials in support of the insertion/withdrawal tests to be conducted to verify analytically determined withdrawal & insertion loads are presented. The reduced data and a brief description of the tests and test facility are included. Two coatings were evaluated; alumina and a self-etching primer. Recommendations on coatings are made on the basis of the coefficient of friction values obtained and on the cost advantages of applying the coating. (auth)

8278 (JUL-944-FF) GUIDE AND PROGRESS REPORT OF THE CRYSTAL LABORATORY, 1969–1973. Wenzl, H. (ed.). Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Festkoerperforschung). Apr 1973. 323p. (In German). Dep. NTIS (U. S. Sales Only) $18.25.

The guide gives a survey of the purpose and organization of the crystal laboratory, as well as an account of the results obtained since its foundation four years ago. The main activities of this laboratory are devoted to the following topics: pure metals and alloys, growth of massive monocrystals, thin films and epitaxy, electrochemical methods, chemical analysis, metal-gas-systems (e.g., Nb–H), equipment and methods (e.g., electro-heating in controlled atmosphere, television systems, vapor-phase growth, crystal shaping, electrical resistivity, x-ray equipment, electron microscopy). (GE)

8279 (N-73-25598) METALLURGY: A COMPILATION. (National Aeronautics and Space Administration, Washington, D.C. (USA)). 1973. 28p. (NASA-SP-5940). NTIS $1.00.

A technology utilization program is presented for the dissemination of information on technological developments that have potential utility outside the aerospace and nuclear communities. Discussion is restricted to the effects of hydrogen on a variety of metal alloys, and the mechanical properties of some recently developed alloys. Hydrogen at both low and high pressure is shown to have adverse effects on alloys such as ultrahigh-strength steels, irradiated steels, niobium, Inconel alloys, titanium alloys, and certain stainless steels. The mechanical and physical properties of a wide range of alloys, their performance at elevated temperatures, and some of the processes involved in their development are also considered. (auth)

8280 (ORNL-tr-2739) FORMATION OF TRANSITION PHASES IN THE ALLOY U-7.5% Nb-2.5% Zr. Giraud-Heraud, F.; Guillaumin, J. Translated from Acta Met.; 21: 1243-1252(1973). 13p. Dep. NTIS $3.00.

The transformation process of a stabilized γ-phase uranium alloy was analyzed by electron microscopy. Some reactions previously identified in some other alloys of this type were evidenced: reactions of continuous and discontinuous precipitation of the equilibrium α phase in the upper temperature range of the T.T.T. diagram of this alloy; a bainitic reaction association with the formation of the α' transition phase in an intermediate range. In the lower-temperature range, some tweed structures were found to be associated with the formation of microdomains of the transition phases γ^3, γ^0, and the α'', explaining the observed contrast effects. These phase transformations were attributed to displacement reactions, previously evidenced in some alloys of titanium and zirconium. (17 figures, 24 references) (auth)

8281 (ORO-3508-9) DIFFUSION OF GASES IN SOLIDS. Tritium Diffusion in Stainless Steel, Zircaloy-2, and Niobium. Period Covered: November 1, 1972–October 31, 1973. Abraham, P. M.; Davis, J.; Pennington, C. W.; Elleman, T. S.; Verghese, K. (North Carolina State Univ., Raleigh (USA). Dept. of Nuclear Engineering). 1973. Contract AT(40-1)-3508. 57p. Dep. NTIS $5.00.

A surface effect which retards the release of recoil-injected tritium was observed for austenitic stainless steel, Zircaloy-2, and niobium. Tritium release from the surface is characterized by diffusion coefficients which are lower than the bulk diffusion coefficients by approximately two orders of magnitude in stainless steel and seven or eight orders of magnitude in Zircaloy-2 and niobium. The transport rate through the surface films appears to be the rate-limiting process for transport through thin specimens of the latter two materials. The effect appears to be associated with the transport through surface oxide films and is not simply a surface-absorption, desorption process. A two-region diffusion model was used to calculate apparent diffusion coefficients and activation energies for transport in the surface films. The surface-layer diffusion coefficients determined for niobium exhibit a change in activation energy at temperatures above 500°C, an effect attributed to the dissolution of the oxide film at high temperatures. The niobium-release results are interpreted in terms of several possible models, and it is shown that the data can fit each model, thereby yielding tritium diffusion coefficients within the surface film and through the film. A three-region diffusion model, which includes the effect of surface films at both specimen faces, was applied to stainless steel and Zircaloy-2 reactor fuel cladding using typical reactor temperatures and times. Predicted tritium release was high for stainless steel-clad elements and low for Zircaloy cladding, in agreement with experimental observation. Tritium diffusion coefficients within the zirconium-oxide surface films on Zircaloy-2 were observed to be essentially independent of oxide film thickness. (16 figures, 30 references) (auth)

8282 EFFECTS OF ALLOYING ON MECHANICAL PROPERTIES OF bcc REFRACTORY METALS. Taylor, G.; Vesely, D.; Christian, J. W. (Oxford Univ.). pp 1-5 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

Recent experimental results obtained on single crystals of bcc metals and alloys are described with special emphasis on the importance which slip line studies have assumed. The following conclusions are reached: (a) very pure Group Va metals exhibit anomalous $(0\bar{1}1)$ slip at low temperatures and Group VI metals have an extended stage 0 followed by normal stage 1 slip; alloys do not show either anomalous slip or appreciable stage 0; (b) $\psi(\chi)$ curves all indicate twinning–antitwinning asymmetry and for alloys, but not for pure Mo, there appears to be an influence of normal stresses at low temperatures; (c) many properties can be explained in terms of the structure of the screw-dislocation core, its distortion under stress, and the consequent differences in screw and non-screw mobilities; alloying effects may be partly due to changes in the effective interionic potential, and stage 0 and anomalous slip are difficult to describe in terms of dislocation properties alone and may depend on source operation. (UK)

8283 DEVELOPMENT OF THERMOMECHANICAL PROCESSES FOR ADVANCED DISPERSION-STRENGTHENED ALLOYS. Ruscoe, M. J. H.; Norris, L. F.; Clegg, M. A.; Evans, D. J. I. (Sherritt Gordon Mines Ltd., Fort Saskatchewan, Alberta). pp 96-100 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

The influence of dispersoid parameters, microstructure, and crystallographic texture on the room-temperature and high-temperature properties of dispersion-strengthened (DS) alloys is reviewed. The dependence of these variables upon thermomechanical processing is shown for the Ni/ThO_2, Ni/Cr/ThO_2, and Ni/Cr/Al/ThO_2 systems. Deformation and annealing processes are studied and mechanical properties and oxidation resistance are determined at temperatures up to 2200°F (1477°K). The application of this work to the production of DS nickel and DS nickel–chromium in the form of sheet and extrusions for high-temperature aircraft turbine engine components is described. (auth)

8284 SOLUTE SEGREGATION AND GRAIN-BOUNDARY EMBRITTLEMENT OF TUNGSTEN. Smith, D. A.; Smith, G. D. W. (Oxford Univ.). pp 144-148 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

The field-ion microscope (FIM) was used to investigate the structure and chemical composition of AKS tungsten (wire doped with aluminum potassium silicate) at the atomic level. The information obtained by this method is confined to samples which seldom contain more than 10^{18} atoms and thus this information can be regarded as complementary to that recorded using Auger electron spectroscopy. The system oxygen in tungsten was selected because oxygen solute in tungsten is associated with characteristic bright image spots. With the reasonable assumption of a correspondence between bright image spots and solute, it is shown that in oxygen-treated tungsten most of the oxygen is present as separate entities (probably atoms) rather than in clusters. There is an extremely sharp peak in the oxygen concentration in the boundary and the boundary is about thirty times richer in oxygen than the neighboring regions (up to ~500 Å away). This region adjoining the boundaries of oxygen-doped specimens contained at least an order of magnitude more oxygen-associated bright spots than either the as-received or vacuum annealed wires. No correlation was found between the boundary segregation pattern and structural features such as grain-boundary dislocations. (UK)

8285 SEGREGATION OF CHROMIUM TO GRAIN BOUNDARIES IN TUNGSTEN. Howell, P. R.; Fleet, D. E.; Page, T. F.; Ralph, B. (Cambridge Univ., Eng.). pp 149-153 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

During investigations into the structure and properties of grain boundaries in tungsten and tungsten-base alloys, a number of solute-grain boundary interactions were observed and quantified using field ion microscopy. The system described is tungsten–30 ppM chromium which exhibited massive condensation of the dopant species to some of the grain boundaries. The system exhibited massive segregation effects which could be quantified for those solute atoms located in or very close to the boundary. Segregation was not observed to a coherent twin in this system, which is to be expected on energy grounds. A rather surprising fact is the "randomness" of the solute distribution in that no tendency towards short-range order or clustering could be identified. It should also be appreciated that no retention events were observed in single-crystal specimens. (UK)

8286 FRACTURE OF ARC-MELTED MOLYBDENUM BELOW 480°K. Thornley, J. C. (International Nickel Ltd., Birmingham, Eng.); Wronski, A. S. pp 154-158 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

The entire ductile–brittle transition range was examined for melted and wrought specimens of fine and coarse grain sizes in order to elucidate the various stages of failure by rupture and by crack propagation. The tensile and compressive yield stresses of all nine batches of material tested which had undergone different thermal or thermo-mechanical treatments resulting in different grain sizes were found to depend on grain size and temperature but not directly on the heat treatment. The ductility transition temperature (T_T) and the transition temperature from failure by cracking to shear rupture by micro-void coalescence (T_F) of the nine batches are tabulated. Nonpropagating grain-boundary microcracks were seen in most of the specimens tested at temperatures above 195°K, but none were detected in test pieces pulled at lower temperatures. Carbide precipitates were seen on the grain boundaries of specimens heat treated above 1823°K, but no cracks were observed in the carbides. A phenomenological examination of the transitions and a discussion of the grain-size dependences of T_T and T_F are made. (UK)

8287 STRENGTH AND DUCTILITY OF NITRIDED 20% Cr, 25% Ni STEELS CONTAINING TITANIUM. Evans, H. E. (Central Electricity Generating Board, Berkeley, Eng.); Raynor, D.; Silcock, J. M.; Roberts, A. C. pp 190-194 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

The effects of composition and thermal treatments on creep-rupture properties of TiN-dispersion-strengthened 20% Cr–25% Ni austenitic steels are discussed. Specimens with titanium additions in the range 0.5 to 2.4% were nitrided at about 1150°C using nitrogen or nitrogen/hydrogen atmospheres and creep-rupture tested at 750 or 850°C. A few specimens with silicon and zirconium additions up to 1.4% and 0.3% respectively were also examined. It is concluded that these nitrided steels therefore behave in a similar manner to other dispersion-hardened materials showing high stress dependencies, high activation energies, and small interparticle spacings and are much stronger than overaged NbC-precipitation-hardened 20% Cr–25% Ni steels. All evidence so far obtained indicates that climb of dislocations over particles is the controlling process. (UK)

8288 DISPERSION-HARDENED BERYLLIUM. Webster, D.; Karlak, R. F.; Vidoz, A. E. (Lockheed Missiles and Space Co., Palo Alto, CA). pp 326-330 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

In an attempt to obtain beryllium with good creep strength at a high fraction of its melting point without deterioration of its already marginal ductility, dispersion hardening was investigated. This material appeared promising since beryllium pressed from powder contains fine BeO particles capable of stabilizing the fine grain size required for low-temperature ductility. Having investigated the structure and properties of beryllium alloys with various oxide morphologies, it is concluded that (a) the creep strength of beryllium at 1800°F is controlled by a dislocation substructure which is stabilized by a fine BeO dispersion, and the volume of liquid phase present in the grain boundaries, (b) the effectiveness of a BeO dispersion in stabilizing a dislocation substructure is inversely proportional to the BeO size for a given volume fraction, and (c) the volume of liquid phase present in the grain boundaries at 1800°F is proportional to the total amount of aluminum, magnesium, and silicon in the alloy. (UK)

8289 AGING OF SOLUTIONS OF CARBON IN VANADIUM. Chang, H. Y.; Wert, C. A. (Univ. of Illinois, Urbana). pp 350-354 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

Specimen preparation consisted of outgassing strips of vanadium in vacuum at 1350 to 1450°C, followed by carburization in a methane atmosphere at 1300°C, hydrogen removal in vacuum at 1000°C, quenching in liquid metal at 60°C from 1400°C in vacuum and aging between 200 and 500°C. Hardness measurements were made of the specimens aged at 200, 260, 350, and 500°C. Results are shown graphically of variation with aging time at 350°C of (a) hardness, (b) tensile strength , and (c) tensile strength for specimens cold-worked 40% by rolling after quenching and prior to aging. Each of these aging curves exhibits three distinct peaks which are considered to be real phenomenon. Examination of the microstructures using transmission electron microscopy showed that these peaks are associated completely with the formation of the coherent precipitate. Aging treatments at other temperatures show the same distinct aging peaks. The kinetics of the system are discussed. There is a striking similarity of behavior in aging of Nb–C and V–C solid solutions and it is considered that this shows beyond doubt that a succession of subtle changes occur in either the micro-chemical or structural features of the coherent precipitate as it grows. (UK)

8290 SOLUTION HARDENING AND SOFTENING IN NIOBIUM-BASE SOLID SOLUTIONS. Ulitchny, M. G.; Vasudevan, A. K.; Gibala, R. (Case Western Reserve Univ., Cleveland). pp 505-509 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

A brief digest of recent results and conclusions on the effects of interstitial and substitutional solute additions on the low-temperature mechanical behavior of Nb and Nb-base alloys are presented. Results show that there are important intrinsic and extrinsic contributions to the low-temperature yield stress of Nb. However, one and only one of the mechanisms of solution softening is operative in Nb alloys—the extrinsic strength of the materials involved. (UK)

8291 INTERSTITIAL SOLUTION HARDENING AND SLIP ASYMMETRY IN TANTALUM. Webb, G. L.; Gibala, R.; Mitchell, T. E. (Case Western Reserve Univ., Cleveland). pp 515-519 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

An experimental study was made of the effect of crystal orientation on the alloy hardening behavior of bcc interstitial alloys. Ta was chosen as the base material with N as the solute. Analysis of slip traces indicated that pure Ta crystals oriented with the maximum resolved shear stress plane (MRSSP) near (121) slipped on the expected (011) plane in tension and (121) in compression, while crystals oriented with MRSSP near ($\bar{1}12$) slipped on ($\bar{1}01$) in tension and on (011) and ($\bar{1}01$) in compression. The yield stresses, resolved on the observed slip planes, were determined at 2% shear strain for pure Ta and Ta doped with 300 at. ppM N. Results are shown as a function of orientation, defined by the angle χ between MRSSP associated with the ($1\bar{1}1$) slip direction and the (011) plane. The yield stresses of pure Ta are as low as or lower than any previously reported values. The yield stresses of Ta–N alloys are shown graphically as a function of N content. The orientation dependence of the yield stress of pure and N-doped Ta is discussed in terms of complex interaction between the applied screw, interstitial solute atoms, and an extended screw dislocation. Results on pure Ta indicate that the orientation dependence of the yield stress at 77°K does not reverse when the sense of shear is reversed. Results on Ta–N alloys agree with previously reported work (Smialek & Mitchell, Phil. Mag.; 22: 1105(1970)) except for the additional strong dependence on orientation. Results indicate that the interaction between interstitial solute atoms and the extended core of the screw dislocation in bcc metals is very complicated. (UK)

8292 SUBSTITUTIONAL SOLID-SOLUTION HARDENING OF TERNARY NIOBIUM ALLOYS. Mizia, R. E. (Westinghouse Electric Corp., Idaho Falls, ID); Koss, D. A. pp 525-528 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

An investigation was carried out to examine the substitutional solid solution hardening of high-purity Nb–W–Mo alloy single crystals. The presence of both thermally activated and athermal components of the yield stress makes interpretation of solid solution hardening difficult; this problem is avoided by separating the components and analyzing them individually. The athermal yield and flow behavior of ternary alloy crystals deformed at 900°K are presented. Results are examined with reference to the athermal yield behavior of high purity Nb–Mo and Nb–W binary alloy single crystals. (UK)

8293 ANALYSIS OF THERMALLY ACTIVATED FLOW IN Fe, Mo, AND Nb. Armstrong, R. W. (Univ. of Maryland, College Park); Campbell, J. D. pp 529-533 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

It is shown that a wide variety of experimental results obtained for the flow stresses of iron, molybdenum, and niobium can be correlated with a thermal-activation rate equation of the form $\tau = \tau_G + \tau_{Th_0}(\dot{\gamma}_0/\dot{\gamma})^{-\beta_0 T}$, where τ_G is the athermal component of stress and $\dot{\gamma}_0$ and β_0 are constants. This form of the rate equation follows from a reciprocal relationship between the activation volume v^* and the thermal component of stress τ_{Th}, which is shown to describe the experimental results for niobium and iron with fair accuracy. The values of τ_{Th} were determined by subtracting from the applied stress an athermal stress component (σ_G) of 8.8 kg/mm^2. When applying the equation to experimental results for polycrystalline materials, the choice of σ_G is crucial, especially at low strain rates or high temperatures. The values taken for this quantity give values for τ_{Th_0} of the order of 10^{-2} times the shear modulus, which is consistent with estimates of the critical resolved shear stress for bcc metals at absolute zero temperature. (UK)

8294 INFLUENCE OF B ON THE PRECIPITATION OF HARDENING BEHAVIOUR OF 18 Cr–10 Ni STAINLESS STEELS CONTAINING Ti OR Nb. Henry, G.; Thomas, B.; Tixier, R. (Institut de Recherches de la Siderugie Francaise, Saint-Germain-en-Laye, France). pp 568-574 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

The influence of small additions of boron (<100 ppM) to laboratory heats of austenitic stainless steels containing titanium and niobium was investigated in relation to the room-temperature mechanical properties and the precipitation structures obtained after quenching and aging in the 600 to 850°C temperature range. The enhanced age-hardening characteristics appear to be associated with modifications in the distribution and morphology of the carbides formed during the aging process, in particular the formation of a random distribution of carbides at temperatures at or below about 750°C. In other cases where random precipitation of MC carbides has been observed, high-strength properties have also been reported. (UK)

8295 SEGREGATION OF ELEMENTS IN TERNARY NICKEL-BASE ALLOYS. Sittner, M. (Statni Vyzkumny Ustav Materialu, Prague). Z. Metallk.; 64: No. 9, 635-639(1973). (In German).

Based on the analysis of a thermodynamic expression for the coefficient of segregation according to M. Hillert, a relation for the segregation of an element X in a ternary Me–X–Y alloy is derived. From this relation and from the experimental investigations it is shown that, by the addition of a third element Y to a binary Me–X alloy, the segregation of the element X is favored if the coefficient of segregation of the element X in a binary Me–X alloy is significantly higher than that of the element Y in a binary Me–Y alloy and if Y increases the thermodynamic activity of X. The experimental verification of the theoretical conclusions on nickel-base alloys has shown that, in Ni–Co, Ni–Cr and Ni–Mo alloys, an addition of silicon will alter the direction of segregation of Co, Cr and Mo; in ternary Ni–Nb–Si alloys the components Nb and Si will segregate into the rim zones of the crystals similar to the behavior of the binary Ni–Nb and Ni–Si systems. (GE)

8296 THERMODYNAMIC CALCULATION OF THE IRON–CHROMIUM–VANADIUM EQUILIBRIUM DIAGRAM. Spencer, P. J.; Counsell, J. F. (National Physical Lab., Teddington, Eng.). Z. Metallk.; 64: No. 9, 662-665(1973).

Assessed thermodynamic data for the binary Fe–Cr, Fe–V, and Cr–V systems were used to calculate the α/sigma phase relations in the ternary Fe–Cr–V system at temperatures of 427, 700, and 900°C. The computer techniques used in carrying out the calculations and the extent of the agreement between calculated and experimentally determined phase boundaries are discussed. (GE)

8297 BRITTLENESS OF COATED TUNGSTEN WIRE. Levinskii, I. V.; Trefilov, B. F.; Dvoichenkova, L. V. (Scientific Research Inst. of Aviation Materials, Moscow). Probl. Prochnosti; 5: 57-59(Jun 1973). (In Russian).

The fracture characteristics of 300- and 500-μ tungsten wires coated with brittle tungsten carbide and recrystallized nickel layers of various thickness were studied experimentally. A fracture mechanism is proposed. As a result of bending strains, a narrow crack forms at the surface of the wire and propagates toward its center. Because of the brittleness of the surface layer, the crack propagates at a high rate, generating an elastic strain wave at its front. When the crack reaches the interface between the brittle layer and the plastic matrix, the stress intensity increases and the shock imparted to the wire leads to fracture. (IAA)

8298 RAMAN INVESTIGATION OF THE PHONON SPECTRUM IN SINGLE-CRYSTAL β-BORON. Richter, W. (Max-Planck-Institut fuer Festkoerforschung, Stuttgart); Hausen, A.; Binnenbruck, H. Phys. Status Solidi (b); 60: No. 1, 461-465(1 Nov 1973).

The Raman spectra of β-rhombohedral boron are reported. Approximately 10 broad structures are found, a number which is much less than the 83 phonons allowed in first-order Raman scattering. In addition, the symmetry selection rules do not hold for these broad peaks. They are thought to be groups of close-lying phonon modes, which might have different symmetry and are broadened by damping. The Raman density of states is discussed. (auth)

8299 ANTIFERROMAGNETISM OF NpPt. Smith, J. L.; Hill, H. H. (Los Alamos Scientific Lab., NM). Phys. Status Solidi (b); 60: No. 1, K61-K63(1 Nov 1973).

Preliminary magnetic susceptibility data from ~5 to 200°K are reported which suggest that NpPt becomes antiferromagnetic below $T_N = 25 \pm 1$°K. μ_{eff} and θ_p are estimated to be $2.4 \pm 0.2\ \mu_B$ per Np atom and -22 ± 8°K, respectively. (DLC)

8300 VARIATION WITH TEMPERATURE OF THE MOESSBAUER PARAMETERS AND THE MAGNETIC PROPERTIES OF YFe_2. Barb, D.; Burzo, E.; Morariu, M. (Inst. of Atomic Physics, Bucharest). Compt. Rend., Ser. A, B; 277: No. 6, 131-134(6 Aug 1973). (In French).

The variation in both the internal fields in ^{57}Fe and the quadrupolar shifts as a function of temperature is studied. These results are related to magnetic measurements. (FR)

8301 MAGNETIC SUSCEPTIBILITY AND ELECTRICAL RESISTIVITY OF $EuSn_3$. Percheron, A.; Gorochov, O.; Achard, J. C. (CNRS, Meudon, France). Compt. Rend., Ser. C; 277: No. 2, 81-83(9 Jul 1973). (In French).

Measurements were made of the magnetic susceptibility and the electrical resistivity of $EuSn_3$ between 10 and 300°K. These measurements established the existence of a magnetic ordering at temperatures beneath 38°K. (FR)

8302 MAGNETIC SUSCEPTIBILITY OF PURE BORON. Kubler, L.; Gewinner, G.; Koulmann, J. J.; Jaegle, A. (Centre Univ., Mulhouse, France). Phys. Status Solidi (b); 60: No. 1, 117-124(1 Nov 1973).

The magnetic susceptibility of various β-rhombohedral boron samples was measured between 4 and 1300°K. An unusual paramagnetic component, with an experimental number of centers dependent on the temperature of the form $N = 2\ N_0 \exp\{-\Delta E/kT\}$, is observed above 500°K. The obtained experimental values are: $\Delta E \approx 0.41$ eV, $N_0 \approx 1.0 \times 10^{22}$ cm^{-3}. ΔE is assumed to be the consequence of a gap of about 0.82 eV between two narrow bands which do not seem to contribute to the conductivity at least for high temperatures (T > 500°K). Moreover, a second contribution is observed increasing linearly above 300°K with rising temperature and becoming less diamagnetic. The slope of the second signal versus temperature is 2.8×10^{-11} cm^3 g^{-1} deg^{-1}. A Curie paramagnetic contribution appears below 77°K, which can be accounted for by a part (5 ppM) of the residual impurities. (29 references) (auth)

8303 KINETICS OF ESTABLISHMENT OF ORDER IN HAMMER-HARDENED Fe–Co–V ALLOYS. Grosbras, P.; Eymery, J. P.; Moine, P. (Laboratoire de Metallurgie Physique, Poitiers, France). Scr. Met.; 7: No. 9, 959-962(Sep 1973). (In French).

The effect of a preliminary hammer hardening on the establishment of order in an Fe–Co–V alloy with 49% Co and 2% V was studied by x-ray diffraction. The samples undergo an homogenization annealing at 800°C for an hour followed by tempering at 780°C. They are rolled at room temperature and a 15-mm tablet is removed from the rolled sample. Order is restored by maintenance of the tablet at a temperature of 440°C. The variation, as a function of time, of the mean height of the antiphase regions and of the order parameter at a long distance S, defined by Bragg and William,

was determined. The results showed that, on the hammer-hardened samples, the restoration of the order degree at long distance is accelerated at the beginning of the ordering kinetics and slowed at the end of the ordering kinetics with respect to the non hammer-hardened samples. Initially order regions have smaller heights in the deformed samples than in the nondeformed samples. At a later stage the deformed specimens have evolution kinetics more favorable than the nondeformed samples. Electron-microscopic studies showed the formation of polygonization subgrains with a sharp disorientation between them. (JSR)

8304 EFFECT OF ALLOYING ON DECOMPOSITION OF Al–Mg SOLID SOLUTIONS. Guseva, L. N.; Nikitina, M. F.; Dolinskaya, L. K.; Egiz, I. V. Izv. Akad. Nauk SSSR, Metal.; No. 4, 208-213(1972). (In Russian).

The effect of the Mg and small additions of alloying elements (Zr, Mo, Ti, Be) on the rate of destruction of Al–Mg alloys at 250°C and their properties after aging at this temperature were studied. In alloys containing up to 11% Mg, the two-phase disintegration of the solid solution was preceded by a single-phase process, the length of which depended on the content of Mg and additives. Zr at first inhibited and decreased the rate of the 2-phase disintegration. Addition of Mo, Ti, and Be along with the Zr caused a breaking up of the structure and an increase in the rate of the 2-phase disintegration. As the 2-phase disintegration developed, there was a loss in plastic strength. Therefore the maximum permissible Mg content is 11%. The addition of small amounts of Zr and Mo is feasible. (tr-auth)

8305 THERMODYNAMICS OF MOLTEN STEEL WITH STRONG REDUCTANTS. Teplitskii, E. B.; Vladimirov, L. P. Izv. Akad. Nauk SSSR, Metal.; No. 4, 51-54(1972). (In Russian).

Characteristics of the thermodynamic nature of the reduction of steel by Ce, Zr, Mg, and Nb were studied. The temperature dependence of the logarithm of the equilibrium constant and the isobaric potential was established for the reduction of steel by strong reductants. The reduction capability of Ce, Zr, Mg, and Nb was determined. (tr-auth)

8306 HYDROGEN SOLUBILITY IN BINARY IRON-BASE MELTS. Nguyen Ngia; Yavoiskii, V. I.; Kosterev, L. B.; Afanas'ev, M. I. Izv. Akad. Nauk SSSR, Metal.; No. 4, 18-24 (1972). (In Russian).

The different type of effect of alloying elements on the solubility of hydrogen in liquid iron is explained by the peculiarity of the electron structure of the elements. A dependence of the parameter of interaction on the atomic number of the element was established. (tr-auth)

8307 INTERACTION OF LAVES PHASES IN $Zr(Fe, Co, Ni)_2$–$ZrMn_2$ SYSTEMS. Pet'kov, V. V. Izv. Akad. Nauk SSSR, Metal.; No. 5, 155-157(1972). (In Russian).

X-ray, thermal differential, and microstructural methods were used to obtain data on the interaction of Laves phases in the subject systems, which typically form limited solid solutions based on binary compounds. (tr-auth)

8308 DEFORMATION AND MICRO-CRACK SUPPRESSION BY LIQUID-PHASE SINTERING OF TUNGSTEN COMPOSITE MATERIALS. Votava, E. J. (Werkstoff-Hauptlaboratorium der DODUCO KG, Pforzheim, Austria). Planseeber. Pulvermet.; 21: No. 2, 79-87(Jun 1973). (In German).

The great ductility of tungsten–nickel–iron heavy metals containing 80–94 wt. % tungsten, and nickel and iron in a ratio of 7:3, appears to be determined by the following factors: (1) formation of a ductile matrix and absence of a brittle WNi_4 phase, which inhibits propagation of surface microcracks at the tungsten grain boundaries and self-healing of internal microcracks; (2) hydrostatic pressure in the interior, which helps to prevent intercrystalline fracture at the tungsten grain boundaries; (3) formation of highly ductile tungsten single-crystal grains, probably due to the very high purity of the material; and (4) good bond between the tungsten grains and the matrix as a result of efficient wetting and prevention of formation of the brittle WNi_4 phase due to the presence of iron. (11 figures, 17 references) (auth)

8309 SOLUBILITY OF Zr IN LIQUID Zn. Ishutin, A. V.; Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P. Izv. Akad. Nauk SSSR, Metal.; No. 6, 75-77(1972). (In Russian).

The solubility of Zr in molten Zn was determined in the temperature interval 650 to 850°C, using the emf method. Results are compared with literature data. (tr-auth)

8310 NEUTRON DEPOLARIZATION IN RARE EARTH METALS NEAR MAGNETIC PHASE TRANSITIONS. Kolesnikov, Yu. M.; Nersesyan, A. A.; Kharadze, G. A. (Inst. of Physics, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 1, 77-80(Jul 1973). (In Russian).

The first-order phase transition from ferromagnetic to the antiferromagnetic helical state in rare-earth metals is considered, and the width of the thermal hysteresis loop of neutron depolarization is estimated for dysprosium. The temperature dependence of neutron depolarization is calculated for a polycrystalline sample of terbium placed in an external magnetic field in the vicinity of the Néel point ($T \approx \vartheta_2$). Results are in good agreement with recent experimental data. (auth)

8311 THERMODYNAMIC PROPERTIES OF LIQUID U–Mn–Zn ALLOYS. Ishutin, A. V.; Lebedev, V. A.; Nichkov, I. F.; Raspopin, S. P.; Povasin, V. E. Izv. Akad. Nauk SSSR, Metal.; No. 5, 169-173(1972). (In Russian).

Addition of Mn to Zn has little effect on the solubility of U in it but markedly affects the thermodynamic properties of the solutions and of the compounds in equilibrium with it. (tr-auth)

8312 ANOMALIES OF THE SPECIFIC HEAT OF SAMARIUM AT HIGH TEMPERATURES. Polovov, V. M. (Inst. of Solid State Physics, Moscow). Zh. Eksp. Teor. Fiz.; 65: No. 4, 1557-1563 (Oct 1973). (In Russian).

Some peculiarities in the specific heat $C_p(T)$ of samarium are observed in the 560 to 700°K temperature range and near 835°K which correspond to the well-known anomalies of its thermal expansion. The anomaly of C_p near 835°K, characterized by hysteresis ~15°, is ascribed to the structural transition from the rhombohedral to hexagonal close-packed lattice determined in earlier work. It is assumed that the broad anomaly of C_p at lower temperatures, which terminates in a δ-singularity at ~694°K with a hysteresis ~3°, is due to an electron phase transition. (auth)

8313 ANOMALOUS SLIP IN HIGH-PURITY VANADIUM CRYSTALS. Taylor, G.; Bajaj, R.; Carlson, O. N. (Iowa State Univ., Ames). Phil. Mag.; 28: No. 5, 1035-1042(Nov 1973).

Single crystals of high-purity vanadium ($\rho_{300}/\rho_{4.2} \sim 1600$) were deformed at 77°K in tension. Results were compared with those on impure vanadium and high-purity niobium of the same orientation. Slip line studies showed that this material deformed largely by slip on the anomalous $(0\bar{1}1)$ plane. This was only the second material known to deform in this way. (auth)

8314 VANADIUM ALLOY. Lensi, P.; Piatti, G. (to EURATOM). Dutch Patent 7,200,886. 21 Jan 1972. (In Dutch).

Available from the Commission of European Communities, Luxembourg.

A new vanadium alloy containing 0.25 to 2.0 wt % of Si and 11 to 15 wt % of Nb has a tensile strength of 50 to 60 kg/mm² at a temperature of 800°C. (EU)

8315 DILATATIONAL MISFIT OF ZIRCONIUM HYDRIDES PRECIPITATED IN ZIRCONIUM. Carpenter, G. J. C. (Chalk River Nuclear Labs., Ont.). J. Nucl. Mater.; 48: No. 3, 264-266 (Oct 1973).

The unconstrained misfit strains, $\delta_{[uvtw]}$, associated with the formation of zirconium hydride precipitates in zirconium were calculated with respect to directions $[uvtw]_{Zr}$. Both the δ-hydride, (normally produced by slow cooling) and the γ-hydride (formed after fast cooling) are considered. Results are shown to be self-consistent and predict the correct volume change caused by the transformation. (auth)

8316 HEAT-TO-HEAT VARIATIONS IN FATIGUE AND CREEP-FATIGUE BEHAVIOR OF AISI TYPE-304 STAINLESS STEEL AT 593°C. Brinkman, C. R.; Korth, G. E. (Aerojet Nuclear Co., Idaho Falls, ID). J. Nucl. Mater.; 48: No. 3, 293-306(Oct 1973).

Results from experimental tests designed to characterize differences in the fatigue or creep–fatigue properties of heats of Type-304 stainless steel are reported. These tests included strain controlled fatigue with and without tensile hold times as well as cyclic stress–strain curve generation at 593°C. Although differences in cyclic hardening characteristics were found in four heats of stainless steel tested, little or no difference in cyclic lifetime occurred, with or without tensile hold times, for three of the heats tested. The fourth heat (Ht. No. 8043813) showed an increased resistance to creep–fatigue damage which was tentatively attributed to subtle differences in residual element chemistry. Bilinear constants were also calculated for the four heats and comparisons are made between bilinear and cyclic stress–strain curves. (3 tables, 7 figures) (auth)

8317 BORON DISTRIBUTION IN HASTELLOY-X. Tanaka, M.; Kawasaki, S. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 48: No. 3, 360-364(Oct 1973).

The distribution of B in Hastelloy-X containing 5 ppM B was studied by means of fission-track etching. Results show that boron segregation decreases with continued aging. Comparison with other heat-resistant materials shows that Hastelloy-X has the widest

temperature range of boron segregation in the early stages of aging. Electron probe x-ray microanalysis show the precipitates to be molybdenum borocarbides, and a tentative mechanism of the decrease of boron segregation with aging is given. (DLC)

8318 STUDIES OF FERROMAGNETIC CRITICAL PHENOMENA BY TEMPERATURE-MODULATION TECHNIQUES. Chaplin, D. H.; Sydney, K. R.; Wilson, G. V. H. (Royal Military Coll., Canberra, Australia). Phys. Lett.; 46A: No. 1, 55-56(19 Nov 1973).

Application of temperature-modulation techniques to determine the temperature dependence of dc magnetization and ac susceptibility of gadolinium metal near the Curie point is described. (auth)

8319 HIGH-PRESSURE STUDY OF THE 37K PHASE TRANSITION OF α-U SINGLE CRYSTAL BY AN AC CALORIMETRIC TECHNIQUE. Chu, C. W. (Cleveland State Univ.); Knapp, G. S. Phys. Lett.; 46A: No. 1, 33-35(19 Nov 1973).

The 37°K phase transition of α-U single crystal was observed by a calorimetric technique to be suppressed by the application of hydrostatic compression. The rate of decrease of the transition temperature T_2 with pressure P is $dT_2/dP = -(3.6 \pm 0.2)$K/kbar. Results qualitatively support the phase diagram of α-U single crystal proposed by Smith. (auth)

8320 OBSERVATION OF MULTIPLE PEAKING AND A POSSIBLE ENHANCED DIFFUSION EFFECT IN CHANNELING ANGULAR DISTRIBUTIONS. Alexander, R. B. (Clarendon Lab., Oxford); Callaghan, P. T. Phys. Lett.; 45A: No. 5, 379-380 (22 Oct 1973).

Multiple peaking was observed in a channelling angular distribution obtained with N ions backscattered from a Br-implanted Fe single crystal. An effect associated with the same distribution is seen which is attributed to the enhanced diffusion of N in Fe. (auth)

8321 LOW-TEMPERATURE MAGNETIZATION OF $TbAl_2$ SINGLE CRYSTALS. Purwins, H. G. (Univ., Geneva); Walker, E.; Barbara, B.; Rossignol, M. F. Phys. Lett.; 45A: No. 5, 427-428(22 Oct 1973).

Magnetization measurements on $TbAl_2$ single crystals are reported for 4.2°K in magnetic fields up to 50 kOe applied in the three symmetry directions; ⟨111⟩ is the easy and ⟨100⟩ the hard direction of magnetization. No quenching of the magnetic moment is observed. Results are interpreted in terms of the crystalline electric field. (auth)

8322 DETERMINATION OF CRYSTAL-FIELD LEVELS IN THE INTERMETALLIC COMPOUND HoRh BY INELASTIC NEUTRON SCATTERING. Chamard-Bois, R.; Rossat-Mignod, J. (CEN, Grenoble, France). Solid State Commun.; 13: No. 10, 1549-1553(15 Nov 1973).

Inelastic neutron time-of-flight measurements were carried out on the intermetallic compound HoRh at different temperatures. Well-resolved transitions between crystal-field levels were observed at 4.0 and 9.7 meV. The complete crystal-field-level scheme was deduced and the crystal-field parameters were found to be $A_4^0\langle r^4\rangle = -10.98$ meV and $A_6^0\langle r^6\rangle = -1.59$ meV. These values deviate considerably from point-charge estimates. (auth)

8323 HIGH-RESOLUTION NMR IN METALLIC SAMPLES OF ^{27}Al AND ^{9}Be. Mehring, M.; Raber, H. (Univ., Dortmund, Ger.). Solid State Commun.; 13: No. 10, 1637-1639(15 Nov 1973).

Four-pulse experiments have been performed on ^{27}Al and ^{9}Be in metallic powder samples. A line-narrowing effect was achieved, which resulted in a symmetric line of about 200 to 300 Hz half width in both cases. No anisotropy was observed, but refined values of the Knight shift were obtained: 1636 ± 3 ppM for ^{27}Al and -10.0 ± 3 ppM for ^{9}Be. (auth)

8324 THERMOPOWER OF PURE TUNGSTEN BELOW 9°K. Trodahl, H. J. (Univ. of Victoria, Wellington, New Zealand). J. Phys., F (London); 3: No. 11, 1972-1976(Nov 1973).

The thermopower of a pure crystal of tungsten (RRR 16300) was measured at temperatures between 2 and 9°K. The thermopower was positive over the entire range with a 0.07 μ VK^{-1} peak near 6.5°K. The temperature dependence may be due to a secondary low-temperature phonon drag peak or to the combination of an electron–electron scattering thermopower and the tail of the primary (80°K) phonon drag peak. (auth)

8325 ACTIVATION ENERGY OF GAS INTERSTITIALS IN bcc METALS. Savino, E. J.; Tewary, V. K. (United Kingdom Atomic Energy Authority, Harwell, Eng.). J. Phys., F (London); 3: No. 11, 1910-1914(Nov 1973).

The activation energies for the migration of nitrogen and oxygen interstitials in niobium, tantalum, and vanadium were calculated by using a Green function method and a model based upon the Flynn and Stoneham theory (Phys. Rev., B1: 3966-78(1970)) of light interstitial migration in solids. Reasonable agreement with the experimental results is obtained. (auth)

8326 QUENCHED-IN VACANCIES IN MOLYBDENUM. Suezawa, M.; Mimura, H. (Tohoku Univ., Sendai). Phil. Mag.; 28: No. 4, 901-914(Oct 1973).

Annealing experiments on quenched-in vacancies were performed with specially prepared high-purity molybdenum wire. The recovery stage was found to be centered at about 370°C, and the activation energy for the recovery was determined to be (1.62 ± 0.27) eV. The activation energy is tentatively considered to be the activation energy for the migration of single vacancies. With the activation energy, the loss of vacancies during quenching is discussed. The loss at the surface is found to be predominant. Correction for this loss was applied to the previously reported quenched-in resistivity results, and the formation energy of a vacancy was redetermined to be (3.24 ± 0.09) eV. These results are discussed in comparison with data on tungsten. (auth)

8327 SOME SUBSTRUCTURAL ASPECTS OF HIGH-TEMPERATURE CREEP IN METALS. Orlova, A.; Cadek, J. (Ceskoslovenska Akademie Ved, Brno). Phil. Mag.; 28: No. 4, 891-899 (Oct 1973).

Some recent data obtained by investigating dislocation substructure formed in high-temperature creep of several metals are summarized, and some aspects of both steady-state and primary creep are discussed on the basis of the data analysis. It is found that similar densities of dislocations unbound in sub-boundaries (free dislocations), ρ, exist in various metals in steady-state creep at the same value of the ratio of applied stress to elastic modulus. In steady state the mean subgrain diameter is proportional to the reciprocal of the square root of the total dislocation density $\rho_t = \rho + \rho_{SB}$, ρ_{SB} being the density of dislocations forming sub-boundaries. Recovery in steady-state creep most probably takes place almost exclusively by annihilation of free dislocations and not be the entry of these dislocations into the sub-boundaries. The total dislocation density was found to increase in the course of primary creep. Most of the dislocations generated go to build the sub-boundaries as the density decreased unless steady state is reached. As the internal stress increases with the strain in primary stage, the main contribution to it most probably follows from subgrain boundaries. (auth)

8328 MAGNETIC CHARACTERISTICS OF LANTHANIDE–COPPER COMPOUNDS WITH $CeCu_6$ STRUCTURE. Coldea, M.; Pop, I. (Univ., Cluj). Phil. Mag.; 28: No. 4, 881-890(Oct 1973).

The magnetic susceptibilities of RCu_6 compounds (R = rare earth) were measured over the temperature range 80 to 1200°K. The contributions to the magnetic susceptibility were the Curie–Weiss term, expressing the paramagnetism of the localized f-electrons and a temperature-independent term for which all the contributions have been estimated. The most important contribution to the temperature-independent term is given by an enhanced Pauli paramagnetism. An expression is proposed for calculating the enhancement factors of the Pauli paramagnetism. The anomalous behavior of the $SmCu_6$ compound results mainly from Van Vleck-type paramagnetism, and could adequately be calculated on the basis of free Sm^{3+} ions, as in the case of the compound $SmAl_3$ (de Wijn, van Diepen and Buschow 1967). (auth)

8329 REMARKS ON THE CONDITIONS FOR MAGNETIC INSTABILITIES IN ACTINIDES: HARTREE–FOCK APPROACH. Continentino, M. A.; Gomes, A. A. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 20: No. 4, 63-84(1973).

In the calculations the criterion for magnetic instabilities in actinides was obtained. This criterion turns out to be of the same form as the Stoner criterion for the one-band problem, but with an effective, q-dependent "exchange" interaction. It should be emphasized that, although Coulomb interactions are described by q-independent parameters, the q dependence arises from the ratio of the d- and f-like susceptibilities and the "mixing" susceptibility. The d–f mixing strength appears in this picture as having two different roles. Firstly, it contributes in modifying the value of the f-like susceptibility $\chi_f(q)$; one sees that a quite strong effect can be obtained when d–f hybridization is turned on; the density of states of f-like electrons may be considerably changed. Secondly, the "effective exchange interaction" may be changed by this effect by changing the d and f susceptibilities and through the $|V_{df}|^2$ coefficient appearing in the definition of $J_{eff}(q)$. Then one expects that if the Stoner criterion is satisfied for a nonhybridized band, when mixing is turned on both $J_{eff}(q)$ and $\chi_f(q)$ change, implying deviation from the condition of magnetic instability. All these effects, however, require detailed numerical investigation, which will be done in the future. (auth)

8330 SURFACE EFFECTS ON DIFFUSION OF TRITIUM IN 304-STAINLESS STEEL AND ZIRCALOY-2. Austin, J. H.; Elleman, T. S.; Verghese, K. (North Carolina State Univ., Raleigh). Contract AT(40-1)-3508. J. Nucl. Mater.; 48: No. 3, 307-316 (Oct 1973).

Tritium diffusion measurements following tritium recoil injection into austenitic stainless steels and Zircaloy-2 exhibit slower hydrogen transport in the surface regions than in the bulk. Kinetics of tritium release from these materials indicate that the release is controlled by a diffusion coefficient that is two to three orders of magnitude lower than the bulk diffusion coefficient for tritium in stainless steel and seven to eight orders of magnitude lower in Zircaloy-2. A two-region classical diffusion model with different diffusion coefficients in each region was developed which appears to adequately represent the surface data for short heating times. Release rates at long heating times are apparently influenced by trapping of hydrogen in surface films. The surface effects are shown not to be due to the helium which is injected into the specimens along with the tritium. (8 figures) (auth)

8331 MODERN FIELDS OF APPLICATION OF REFRACTORY METALS AND ALLOYS. Sedlatschek, K. (Metallwerk Plansee, Reutte/Tyrol, Austria). Molybdaen-Dienst; No. 87, vp(1973). (In German).

A survey is given of the preparation, properties and uses of the compound material Mo–ZrO_2–"cermotherm" and of molybdenum and tungsten alloys. (GE)

8332 DIFFUSION OF ^{140}La IN bcc γ-LANTHANUM AND δ-CERIUM. Dariel, M. P. (Israel Atomic Energy Commission, Negev). Phil. Mag.; 28: No. 4, 915-922(Oct 1973).

The serial-sectioning method was used to determine the self-diffusion coefficients in bcc γ-lanthanum and the solute diffusivities of lanthanum in bcc δ-cerium. The results are expressed by $D_{La}La = 1.3 \times 10^{-2} \exp(-24500/RT)$ cm^2 sec and $D_{Ce}La = 3.8 \times 10^{-2} \exp(-24500/RT)$ cm^2/sec. The similarity of the diffusion characteristics in the different rare-earth metals casts doubt on the validity of the activated interstitial model put forward in order to account for the peculiar diffusion behavior in the bcc phases of cerium and plutonium. (auth)

8333 CHANGE IN THE ORDER OF A MARTENSITIC PHASE TRANSFORMATION BY AN EXTERNAL FIELD. Schuster, H. G. (Brookhaven National Lab., Upton, NY). Solid State Commun.; 13: No. 9, 1361-1363(1 Nov 1973).

It is shown, on the basis of the Labbé–Friedel model (J. Phys. Rad., 27: 153, 303, 708(1966)) for A_3B compounds that the martensitic phase transformation in Nb_3Sn can be changed from a first- to a second-order transition by an external stress. The Hamiltonian operator describing the phase transition in an external stress field was mapped to a spin-½ Ising model with infinite-range interactions showing a second-order phase transition. Estimates of the transition temperature and the maximum order parameter are given, suggesting new experiments. (auth)

8334 TEMPERATURE DEPENDENCE OF THE SOFT ACOUSTIC SHEAR MODES IN hcp ZIRCONIUM. Moss, S. C.; Keating, D. T.; Axe, J. D. (Brookhaven National Lab., Upton, NY). Solid State Commun.; 13: No. 9, 1465-1467(1 Nov 1973).

Neutron measurements of the dispersion curve $\nu(q)$ for [10.0] phonons polarized in [11.0] are presented for hcp Zr at 300, 773, and 1073°K. Given that the crystal transforms to bcc at 1135°K and demonstrates a pronounced softening in the C_{66} elastic constant, $\nu[q]$ shows only a uniform lowering of the entire branch, consistent with the behavior of $C_{66}(T)$ but fractionally smaller for large wave vectors. No anomalous phonon linewidths are observed. (auth)

8335 SEPARATION OF 5d AND 4f CONTRIBUTIONS TO THE ELECTRIC FIELD GRADIENT IN HEAVY RARE EARTHS. Devine, R. A. B. (Univ. of Montreal). Solid State Commun.; 13: No. 9, 1495-1497(1 Nov 1973).

The conduction electron contribution to the electric field gradient in heavy rare earth metals (Gd, Er, Tm, Tb, Dy, Ho) is calculated assuming 5d virtual bound state character present. The results are in better agreement with experiment than found previously and predict antishielding parameters for Er and Tm, in good agreement with those calculated directly. (auth)

8336 EFFECT OF STRESS ON HYDRIDE PRECIPITATION BEHAVIOR IN ZIRCALOY-2. Maki, H. (Hitachi Ltd., Ibaraki, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 8, 470-477(Aug 1973).

Hydride directionality in Zircaloy is reportedly affected by thermal cycling and stress. Experiments were performed to study these effects quantitatively. The first experiment was thermal cycling applied repeatedly on rolled Zircaloy-2 plate under tensile load. It was observed that, at the first cycle, the hydride directionality changed by an amount depending on the stress level, and thereafter, upon repetition of the thermal cycling, the rate of change was slow and steady, and independent of the level of applied stress. In arranging the data, a new concept, termed the "average precipitation angle," is proposed to express hydride directionality, in which account is taken of the length and the angle of precipitation of the hydride platelets. This concept should at times be more suitable than the currently adopted directionality factor F^n for methodically expressing hydride directionality. Based on the results of this experiment, the average precipitation angle in Zircaloy-2 cladding in reactors can be estimated with the empirical formula $A_r = A_0 + \alpha\sigma_t + \beta(C - 1)$, where A_0 and A_r: average precipitation angles before and after reactor service, σ_t: tangential stress, C: number of thermal cycles, α and β: constants. Another experiment was carried out to determine the constant α for Zircaloy-2 tubing serving in water-cooled reactors. This experiment was on thermal diffusion under internal pressure and thermal conditions simulating those of Zircaloy-2 fuel cladding in water-cooled reactors. When the specimens were prepared for the foregoing experiments by hydriding, the hydride platelets did not distribute uniformly across the wall thickness. It was clarified by a third experiment that the hydride precipitated preferentially in the zones subjected to large residual tensile stress. (auth)

8337 PROPERTIES AND APPLICATIONS OF SOME SPECIAL METALS. Perez, M.; Silberman, S.; Syre, R. (Ugine Aciers Sepciauz, Saint-Denis, France). Mater. Tech.; No. 6, 224-230 (Jun 1973). (In French).

Properties of zirconium, tantalum, niobium, and beryllium are considered; examples of the application of these metals to the nuclear energy, chemical, aeronautic, electrical, electronic, and space industries are presented. (France)

8338 STUDY OF PREPLASTIC DEFORMATION STRESSES IN NIOBIUM MONOCRYSTALS FROM INVESTIGATIONS OF RELAXATION PHENOMENA. Boudet, A.; Kubin, L. P. (CNRS, Toulouse). Compt. Rend., Ser. A, B; 276: No. 25, 925-928(18 Jun 1973). (In French).

The behavior of niobium monocrystals in the preplastic region was studied as a function of the density of edge dislocations found in the sample. Tests were made on stress relaxation. A relaxation delay time was observed which seems to be connected with the disappearance of the available mobile dislocations. (France)

Radiation Effects

Refer also to abstracts 9254, 9343, and 9346.

8339 (AEC-tr-7500) EXPERIMENTAL METHOD FOR DETERMINING THE SIZE OF A DISLOCATION LOOP NUCLEUS. Leteurtre, J.; Pouchou, J. L.; Zuppiroli, L. Translated from Phil. Mag.; 27: No. 6, 1323-1334(1973). 14p. Dep. NTIS $3.00.

The basic experiment for this method consists in measuring the dimensional changes of a single crystal irradiated under a uniaxial stress. By favoring some Burgers vectors to the detriment of others, the stress induces some artificial anisotropy which is directly related to the nucleation process. More precisely, the induced-growth coefficient measuring this anisotropy is shown to depend strictly on the vacancy and interstitial-nuclei sizes. The statistical hypothesis which leads to this result is discussed. Finally, it is shown that the extra stress induced by the grown-up dislocation loops on a nucleating loop have no influence on the measured dimensional changes. (auth)

8340 (AERE-PR/Met-7, pp 4.1-4.10) DEVELOPMENTS IN THE ELECTRON-PROBE MICROANALYSIS AND THE SCANNING ELECTRON MICROSCOPY OF RADIOACTIVE MATERIALS. Adam, J. Sep 1973.

Metallurgy Division highlights progress report, January 1972–December 1972.

The value of electron-probe microanalysis and of scanning-electron microscopy to the technological and fundamental studies of nuclear reactor materials is well recognized. There are two special features of irradiated materials that make the use of both techniques difficult: radioactivity of samples and complexity of structures and compositions due to transmutations caused by fission. The former presents a health hazard to the operator and frequently adversely affects the performance of the equipment; the latter means that the examination of each sample is a long and often tedious process. To combat difficulties created by radioactivity of samples, shielding and screening must be provided while automation or other time- and tedium-saving devices are highly necessary to extract as much information as possible from the complex specimens. Descriptions are given of these two developments, and some examples of their application. (UK)

8341 (AGC-2277(Vol. 2)(Rev.)) RADIATION EFFECTS DATA BOOK. Volume 2. Appendices. (Aerojet-General Corp., Azusa, Calif. (USA)). 30 Sep 1963. 381p. Dep. NTIS $21.25. Declassified 28 Aug 1973.

The appendixes are on effects of radiation on materials, Nerva

radiation environment, nuclear radiation heating, neutron heating, shielding, facilities for radiation effects experiments, dosimetry, radiation environment in space, and radiation effects information sources. (JRD)

8342 (ANL-8035, pp 165-179) INTERACTION OF ENERGETIC PARTICLES WITH SOLIDS. 1973.
In Physics Division annual review, 1 April 1972-31 March 1973.

8343 (BAW-10006(Rev.3)) REACTOR VESSEL MATERIAL SURVEILLANCE PROGRAM. Snyder, G. J.; Carter, G. S. (Babcock and Wilcox Co., Lynchburg, Va (USA). Nuclear Power Generation Dept.). Oct 1973. 32p.
B&W conducts surveillance programs for its 850-MW(e) class of reactors to determine the effects of neutron irradiation on the full Charpy V-notch curves of the reactor vessel materials. Charpy and tensile specimens, which are machined from as-fabricated metal, heat-affected-zone metal (HAZ), and weld metal, are placed in six surveillance capsules containing dosimeters and temperature monitors. The capsules are then placed in three holder tubes, which are positioned so that the capsules are near the peak axial neutron flux. In the Oconee 1 and Three Mile Island 1 plants, two thermal aging capsules have been placed in an area of essentially zero flux. In the remainder of the 850-MW(e) class plants, thermal aging boxes will contain specimen plates of reactor-vessel materials. The flux level at the box location will be practically zero. However, the thermal environment at the box location between the vessel upper head and the insulation will be almost identical to that of the surveillance capsule. These specimen plates will be available for future use as thermally aged specimens. The holder tubes are attached to the thermal shield and can be installed and removed along with the internals core support assembly. Once the internals are installed, the holder tubes are rotated toward the vessel's wall and locked in place at favorable locations for irradiation of the specimens. Calculations indicate that B&W's method is a reliable, conservative means of predicting peak neutron fluence. (auth)

8344 (CONF-730958-3) COMPUTER STUDIES OF REPLACEMENT SEQUENCES IN SOLIDS ASSOCIATED WITH ATOMIC DISPLACEMENT CASCADES. Holmes, D. K.; Robinson, M. T. (Oak Ridge National Lab., Tenn. (USA)). 1973. 22p. Dep. NTIS $3.25.
From third international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973).
Focused sequences of replacement collisions have been studied, especially in association with radiation damage cascades. Radiation-damage events are simulated using a computer program based on binary collision approximations. The results are averaged over a complete set of initial directions of the primary knock-on atom for each primary energy to obtain quantities of physical interest for which the effects of replacement sequences may be made explicit. The calculations are compared with recent experimental results. (auth)

8345 (CONF-731028-3) EFFECT OF He^+ AND D^+ ION BEAM FLUX ON BLISTER FORMATION IN NIOBIUM AND VANADIUM. Das, S. K.; Kaminsky, M. (Argonne National Lab., Ill. (USA)). 1973. 13p. Dep. NTIS $3.00.
From international conference applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973).
The effect of incident ion beam flux on the blister formation in annealed polycrystalline niobium and vanadium has been investigated for 0.5-MeV He^+ and 0.25-MeV D^+ projectiles. For the He^+ ions the flux was varied from 1×10^{13} ions/(cm^2-sec) to 1×10^{15} ions/(cm^2-sec), the targets were held at 900°C, and the total dose was varied from 0.1 to 1.0 C/cm^2. For the D^+ ion irradiation the flux was varied from 1×10^{14} to 1×10^{15} ions/(cm^2-sec), the niobium targets were held at 700°C, and the total dose was 2.0 C/cm^2. For both the helium implanted vanadium and niobium the blister density shows a stronger flux dependence than the average blister diameter. For deuteron implanted niobium the blister size increased as the flux was increased from 1×10^{14} to 1×10^{15} ions/(cm^2-sec). (auth)

8346 (CONF-731101-36) TEM INVESTIGATION OF 14-MeV NEUTRON DAMAGE. Merkle, K. L. (Argonne National Lab., Ill. (USA)). Nov 1973. 36p. Dep. NTIS $4.00.
From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).
14-MeV neutron damage has been investigated in gold by means of transmission electron microscopy (TEM). The sites of energetic displacement cascades are visible due to the presence of vacancy clusters formed by the collapse or rearrangement of vacancies within the depleted zones. In 14-MeV n-induced cascades, a strong tendency towards subcascade formation is found. On the average 1.8 clusters are formed per cascade. Individual cascades with as many as 6 subcascades have been found. The number densities of clusters as well as the number densities of cascades are proportional to the fluence. The cross section for the formation of visible cascades is $\sigma_c = 3.3 \times 10^{-24}$ cm^2. It can be shown that recoils from elastic neutron scattering events can account for only about 20% of the visible cascades. The cross section corresponding to the balance of the observed cascades is, within experimental error, equal to the nonelastic neutron scattering cross section. This indicates that all nonelastic scattering events lead to the formation of a visible cascade. Quantitative agreement with what is expected from heavy ion bombardments regarding the cross sections involved is found, however, estimates of the average cascade energy in the 14-MeV neutron bombardments are somewhat higher than expected. (10 figures, 29 references) (auth)

8347 (CONF-731114-14) EFFECT OF HELIUM ON HIGH-TEMPERATURE TENSILE PROPERTIES AND SWELLING OF VANADIUM AND VANADIUM ALLOYS. Santhanam, A. T. (Argonne National Lab., Ill. (USA)). 1973. 6p. Dep. NTIS $3.00.
From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).
Sheet tensile samples of V-15 wt % Cr-5 wt % Ti were implanted with ~25 atomic ppM of helium at the ANL Cyclotron and tested at temperatures from 650 to 900°C. When compared with the control samples, the helium-injected samples show an increasing loss of ductility with increasing temperatures above 700°C. The loss of ductility in the helium-injected samples is accompanied by transition from a ductile, transgranular fracture to a completely intergranular fracture. The control samples fracture transgranularly throughout the range of test temperature. The effect of helium on void swelling was studied in two grades of vanadium using heavy-ion bombardment. High-purity vanadium (145 ppM C + N + O) and commercial-purity vanadium (1220 ppm C + N + O) were bombarded with 3.25-MeV Ni^+ ions at 650 and 750°C to a damage level of 60 displacements per atom after preinjection with helium. Quantitative microscopy of the irradiated samples showed that the overall swelling was unaffected at 650°C, but was significantly reduced at 750°C, if the helium content was increased from 10 to 100 atomic ppM. The reduction in swelling appears to be associated with the presence of a high concentration of small helium bubbles that act as the predominant sinks for the radiation-induced point defects. (auth)

8348 (CONF-731114-19) VOID SWELLING OF NIOBIUM AND NIOBIUM + 1 w/o ZIRCONIUM ALLOY. Loomis, B. A.; Taylor, A.; Gerber, S. B. (Argonne National Lab., Ill. (USA)). Oct 1973. 8p. Dep. NTIS $3.00.
From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).
The void swelling of Nb and a Nb + 1 wt % Zr alloy at 600 to 1000°C after $^{58}Ni^+$ bombardment has been determined. Also, the effect on void swelling of oxygen impurity in Nb and Nb + 1 wt % Zr has been determined. These results are used to suggest that the Nb + 1 wt % Zr alloy may be a suitable choice for construction of the vacuum wall for a fusion reactor. Niobium, however, does not seem to be a good choice for the vacuum wall. (auth)

8349 (LBL-1450) CONTRIBUTION OF RADIATION DAMAGE TO THE STUDY OF BASIC ATOMIC MOTION IN SOLIDS. Seshan, K. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Feb 1973. Contract W-7405-eng-48. 23p. Dep. NTIS $3.25.
Radiation damage is a powerful tool for the study of point-defect interactions in solids. The large numbers of point defects produced during irradiation and subsequent annealing aggregate to form planar and linear defects. A study of the nature of these defects provides basic understanding of the mechanics of defect formation in solids. Defects in ion-bombarded silicon are studied using the transmission electron microscope. A mechanism for the formation of the observed defects is proposed. The utility of radiation damage studies in the understanding of atom motion in solids is demonstrated. (auth)

8350 (NRL-7573) RADIATION-EMBRITTLEMENT RESISTANCE OF ADVANCED NiCrMo STEEL PLATES, FORGINGS, AND WELDMENTS. Hawthorne, J. R. (Naval Research Lab., Washington, D.C. (USA)). 13 Sep 1973. 29p.
The 550°F irradiation response characteristics of several NiCrMo steel plates, forgings, and weldments were evaluated. Primary objectives were to explore variable radiation-embrittlement tendencies and to assess notch ductility performance relative to that of the MnMoNi steel (ASTM Type A533-B) currently used in nuclear reactor vessel construction. The study was focused on ASTM Type A543 steel in Class 1 and Class 2 heat treatment conditions. Both submerged arc and electroslag weldments were evaluated. Irradiation embrittlement was indexed by the increase

in Charpy-V 30 ft-lb transition temperature. Results clearly demonstrate the promise of ASTM Type A543 plate and related A508 forging steels for advanced reactor applications. Both radiation-embrittlement resistance and preirradiation transition temperature characteristics were found superior to those of standard production A533-B. With only two exceptions, the A543 plates and A508 forgings exhibited sufficient resistance to a fluence of 4×10^{19} n/cm^2 > 1 MeV to retain a subzero nil-ductility transition (NDT) temperature. Weld deposits generally had higher post-irradiation transition temperatures than plates. The significant variability in radiation resistance noted among A543 plates and weld deposits could be traced in most instances to composition differences, especially residual element content differences. Anomalous weld heat-affected-zone (HAZ) behavior relative to weld thickness location was observed. A progressive increase in irradiation response with an increase in copper content was found. Vanadium content appears detrimental to radiation resistance of NiCrMo plates, but not to NiCrMo forgings. Weld deposit results infer a harmful effect of nickel content when chromium content is low. Notch ductility recovery by postirradiation heat treatment was also explored. (auth)

8351 (RISO-M-1663) COMMENTS ON STAGE III AND STAGE IV ANNEALING MECHANISMS IN MOLYBDENUM Evans, J. H. (Danish Atomic Energy Commission, Risoe. Research Establishment). Oct 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Recent work on molybdenum giving evidence for interstitial and vacancy migration in stages III and IV, respectively, was critically examined. Although the suggested annealing scheme is attractive, it is demonstrated that the evidence does not quantitatively support such a model. Alternatively it is argued that other investigations, including recent positron annihilation studies, point strongly to vacancy migration in stage III. In addition, it is proposed that stage IV after neutron irradiation is due to the migration of some small vacancy cluster, possibly the trivacancy or tetravacancy. (auth)

8352 (WANL-TME-1281) CRYOGENIC IRRADIATION EFFECTS IN NERVA STRUCTURAL ALLOYS. Begley, J. A. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 10 Sep 1965. 62p. Dep. NTIS $5.25.

Declassified 4 Sep 1973.

A study of cryogenic irradiation effects in NERVA structural alloys is described. Notched and unnotched specimens of Inconel 718, Inconel X-750, aluminum alloy 2219-T6, titanium alloy 5Al–2.5 Sn(ELI), beryllium, AISI 301, and AISI 303 Se stainless steels were irradiated in the Ground Test Reactor (GTR) at –320°F to neutron doses from 4×10^{17} to 1.1×10^{18} n/cm^2 (E > 1 MeV). These doses correspond to about 20 minutes of NERVA full power operation. Tensile tests were performed at –320°F, both before warming from the irradiation temperature and after various annealing treatments. Ambient and elevated-temperature tests were also conducted. In addition, stress relaxation and spring-constant changes in cold-worked AISI 302 springs were investigated. Irradiation effects were noted in all materials. In situ (before warming from the irradiation temperature) damage was particularly pronounced. Beryllium and Ti–5Al–2.5 Sn(ELI) were most seriously affected, with beryllium experiencing a 71% drop in strength. Partial or complete recovery of damage occurred at 80°F for all specimens and no damage was noted at elevated temperatures of 540°F and above. Marked differences were observed in the behavior of sheet and bar stock of the same alloys. (auth)

8353 IONOMETRIC INVESTIGATION OF THE EFFECT OF PROTON IRRADIATION ON PURE AND IMPURE BISMUTH. Goets, G.; Gumanskii, G. A.; Tashlykov, I. S.; Shvabe, F. (Belorussian State Univ., Minsk). Inzh.-Fiz. Zh.; 25: No. 1, 164 (Jul 1973). (In Russian).

Samples of pure bismuth and its alloys containing 0.2, 0.6, and 1.0 at. % lead were irradiated with 100-keV protons at an integral flux of 5×10^{15} to 1.0×10^{16} cm^{-2}. After each irradiation, backscattering spectra were taken. Then the sample was annealed 4 h at 120°C and the backscattering spectrum was taken again. The composition dependence of the number of displaced atoms was obtained for the first and second irradiations. With increasing lead content, the irradiation defects tend to decrease. This fact can be related to the incorporation of lead-impurity atoms which lead to ordering of the crystal lattice of bismuth. Repeated irradiation leads primarily to the formation of ordinary radiation defects, a significant fraction of which are captured by traps. Thus there is only a small increase in the number of stable defects. (SJR)

8354 INFLUENCE OF NEUTRON BOMBARDMENT ON MECHANICAL PROPERTIES AND EFFECT OF PROGRAMMED HARDENING OF TITANIUM. Gindin, I. A.; Lapiashvili, E. S.; Naskidashvili, I. A.; Neklyudov, I. M. Probl. Prochnosti; No. 8, 49–52(Aug 1973). (In Russian).

Results are presented from studies of the influence of neutron bombardment by integral doses of 1.2×10^{18} and 3.2×10^{18} n/cm^2 at 130°C on the mechanical properties of polycrystalline titanium and the effect of additional hardening following annealing without load and under smoothly increasing load in the macroelastic area of deformation at 20 and 200°C. It is shown that bombardment increases the yield point by approximately 40%, while bombardment with subsequent annealing under smoothly increasing load increases the yield point of titanium to almost double its original value. VT-1 titanium was used in the study. (JPRS)

8355 IRRADIATION HARDENING OF IRON ALLOYS. Igata, N. (Tokyo Univ.); Hasiguti, R. R.; Watanabe, K. pp 21-25 of Microstructure and Design of Alloys. Vol. 1. London; Iron and Steel Inst. (1973).

From 3rd international conference on the strength of metals and alloys; Cambridge, England (20 Aug 1973).

Neutron-irradiation hardening of iron alloys containing interstitial impurities N and/or C and a substitutional impurity Cr, Mo, V, or Cu was investigated. The increase of yield stress by neutron irradiation is explained in terms of obstacle hardening. The obstacle is considered to be a complex consisting of nitrogen or carbon atoms and radiation induced lattice defects. A substitutional impurity such as V, which strongly forms nitride or carbide, suppresses the formation of the above complex, and reduces the obstacle hardening. Weak nitride- or carbide-forming substitutional impurities are less effective in suppressing the complex formation and in reducing the obstacle hardening. The work-hardening coefficient n, which is obtained from the true stress–strain curve, decreases by neutron irradiation. This decrease is explained in terms of obstacle hardening and some additional experimental findings. (UK)

8356 EFFECT OF NEUTRON IRRADIATION ON THE ELASTIC CONSTANTS OF TYPE-304 STAINLESS STEEL. Straalsund, J. L.; Day, C. K. (Westinghouse Hanford Co., Richland, WA). Nucl. Technol.; 20: No. 1, 27-34(Oct 1973).

An ultrasonic technique was used to determine elastic moduli of Type-304 stainless-steel samples irradiated to fluences as high as 7.5×10^{22} n/cm^2 (E > 0.1 MeV). Significant decreases in the elastic moduli were found, which correlate linearly with irradiation-induced swelling. The Young's modulus was found to decrease ~2.4% per 1% swelling. (auth)

8357 DISLOCATION STRUCTURE AND WORK HARDENING OF COPPER SINGLE CRYSTALS WITH [100] AXIS ORIENTATION. I. Dislocation Arrangement and Cell Structure of Crystals Deformed in Tension. Goettler, E. (Technische Univ., Brunswick, Ger.). Phil. Mag.; 28: No. 5, 1057-1076(Nov 1973). (In German).

Copper single crystals with [100] axis orientation were deformed in tension at room temperature and after load removal were irradiated with neutrons to stabilize the dislocation arrangement before the preparation of thin foils. TEM investigations of {111}-, {110}-, and {100}-foils and the analysis of Burgers vectors and line vectors yielded the essential information about the dislocation arrangement. A cell structure was observed which was, in principle, the same in all stages of deformation. This cell structure consisted of nearly dislocation-free regions of varying sizes surrounded by walls of dislocation networks without preferred orientation. The most important parameters of this dislocation structure were measured as a function of stress: dislocations of all 6 Burgers vectors—including those which do not operate under the external stress—occur with equal frequency. The same was true for the different characters of dislocations. Total dislocation density ρ: $\gamma = 0.30\ \mathrm{Gb}/\rho$. Mean diameter of cells $D = 4.2\ \mathrm{Gb}/\gamma$. Ratio of dislocation free areas to the total area of the glide plane $p(\gamma) = 0.55$ = constant. The average diameter of the walls was nearly proportional to $1/\gamma$. Results were compared with other measurements. (auth)

8358 PROTON SIMULATION OF DISPLACEMENT EFFECTS INDUCED IN METALS BY 14-MeV NEUTRONS. Logan, C. M. (Univ. of California, Livermore); Anderson, J. D.; Mukherjee, A. K. J. Nucl. Mater.; 48: No. 3, 223-232(Oct 1973).

In designing a D–T fusion reactor, one must know the effect of a high flux of 14-MeV neutrons on structural materials. Available laboratory sources of 14 MeV neutrons are not intense enough to expose samples to the expected flux. Bombardment with other particles is one way of simulating the anticipated neutron environment. The energy spectrum of atoms recoiling from collisions with bombarding particles can be calculated from elastic-scattering and nonelastic-reaction data for the incident species. This analysis shows that 16-MeV protons closely simulate the displacement effects caused by 14-MeV neutrons. In niobium, the average atom

recoiling from a 14-MeV neutron interaction was 65 keV of damage energy. The mean damage energy deposited per cm^3 of niobium by a fluence of one 14-MeV neutron per cm^2 is 14 keV. The equivalent quantity for 16-MeV protons incident on niobium is 33 keV. (7 figures, 27 references) (auth)

8359 NICKEL-ION BOMBARDMENT OF ANNEALED AND COLD-WORKED TYPE-316 STAINLESS STEEL. Johnston, W. G. (General Electric Corp., Schenectady, NY); Rosolowski, J. H.; Turkalo, A. M.; Lauritzen, T. J. Nucl. Mater.; 48: No. 3, 330-338(Oct 1973).

Bombardment with high doses of 5-MeV nickel ions produced swellings as high as 90% and 60%, respectively, in annealed and 20% cold-rolled Type 316 steels. The steels contained 15 ppM of cyclotron-injected helium. Swellings were determined by both transmission electron microscopy and by a step-height method that measures the total swelling integrated along the ion path. The swelling in annealed Type 316 has a pronounced peak in the vicinity of 625°C, which is about 155°C higher than the peak swelling temperature in-reactor. The magnitudes of the swelling, void densities, and void sizes produced in annealed Type 316 by nickel ions and in-reactor at the respective peak swelling temperatures are similar and it is concluded that the nickel ion bombardments provide an acceptable simulation of in-reactor behavior. Use of the high dose ion results to guide extrapolation of presently available EBR-II data to higher fluences leads to the prediction that the swelling of annealed Type 316 steel at the peak swelling temperature will reach 40% at 2×10^{23} n/cm^2 (E > 0.1 MeV) in EBR-II core, and 70% at 3×10^{23} n/cm^2. These fluences in EBR-II correspond to 155 and 230 dpa respectively. Twenty percent reduction by cold-rolling reduces the ion-produced swelling by 35% at 625°C and by 50% at 575°C. (10 figures) (auth)

8360 FLUENCE AND TEMPERATURE DEPENDENCE OF SWELLING IN IRRADIATED MOLYBDENUM. Brimhall, J. L.; Simonen, E. P.; Kissinger, H. E. (Battelle Pacific Northwest Labs., Richland, WA). J. Nucl. Mater.; 48: No. 3, 339-350(Oct 1973).

Volume changes were analyzed in molybdenum neutron-irradiated to various fluences over the temperature range 50 to 1300°C. This data together with all previously reported data were compiled into a three-dimensional plot of swelling versus temperature versus fluence. Significant low-temperature swelling, <400°C, is observed and is consistent with the presence of isolated immobile vacancies. Void swelling only becomes significant at temperatures >400°C. The nature of the dislocation and void microstructure at high irradiation temperatures are analyzed quantitatively as a function of irradiation temperature and the results are reasonably consistent with a recent model of Brailsford and Bullough. The same model is also consistent with an observed trend towards saturation in the void swelling at high fluences at the low temperature end of the void region. (6 figures, 22 references) (auth)

8361 CHANGE IN OXYGEN SNOEK DAMPING AND TRANSMISSION-ELECTRON-MICROSCOPE OBSERVATIONS OF NEUTRON-IRRADIATED VANADIUM. Eto, M. (Tokyo Univ.); Fukaya, K.; Shiraishi, K. J. Nucl. Mater.; 48: No. 3, 365-368 (Oct 1973).

A study was made of the role of O in radiation-anneal hardening of V by correlating the changes in the O Snoek damping and the lower yield stress with electron microscopic observations. The irradiation dose was 2×10^{17} n/cm^2 of fast neutrons. Results indicate that the O atoms migrate and are trapped by defect clusters. Recovery of the Snoek damping is probably due to the re-solution of O due to heat treatment. (DLC)

8362 HIGH-VOLTAGE ELECTRON MICROSCOPE STUDY OF EFFECTS OF PREINJECTED HELIUM ON ELECTRON DAMAGE IN ALUMINUM. Wolfenden, A. (Oak Ridge National Lab., TN). Micron; 4: No. 2, 204-215(1973).

Defect clusters were formed and observed simultaneously in electron-irradiated foils of aluminum, both uninjected and preinjected with about 8 atomic ppM helium, in a high-voltage electron microscope operated at 650 kV. The nominal irradiation temperatures of the specimens were room temperature, 150°C and 200°C. The defect clusters in the form of dislocation loops formed in greater concentrations and persisted to longer times in the preinjected specimens than they did in the uninjected metal. At 200°C, no beam-induced loops were observed in the uninjected aluminium foil of usual thickness, but they were seen in the helium injected material. Faulted dislocation loops were more prevalent in the preinjected specimens. Under certain conditions the irradiated microstructure evolved to one resembling an unirradiated structure. It is concluded that the preinjected helium itself (rather than the associated alpha particle damage) causes the enhanced dislocation loop formation in the electron-bombarded foils. (auth)

8363 INTERACTION BETWEEN POINT DEFECTS, BLOCH WALLS, AND DISLOCATIONS IN LOW-TEMPERATURE ELECTRON-IRRADIATED NICKEL. Soulie, J. C.; Minier, C.; Lauzier, J. (CEN, Grenoble, France). Phil. Mag.; 28: No. 4, 739-747 (Oct 1973). (In French).

The irradiation of a nickel sample at 29°K with 2-MeV electrons followed by an isochronal thermal treatment resulted in (a) a bulk elastic effect depending on the global concentration of point defects, (b) a reorientation effect of these defects and their interaction with Block walls, (c) a pinning of the dislocation lines during the migration, at long distance, of the point defects. (auth)

8364 SNOEK PEAK OF NEUTRON-IRRADIATED Fe–3.48 Ni ALLOY. Yamane, T.; Takahashi, J. (Osaka Univ., Suita, Japan). J. Nucl. Sci. Technol. (Tokyo); 10: No. 9, 556-559(Sep 1973).

The Snoek peak of a neutron-irradiated Fe–3.48% Ni alloy was measured to determine the resolution of interstitial impurity atoms. The internal friction was measured after isothermal annealing on specimens irradiated at 75 ± 10°C to a dose of ~3.6×10^{19} nvt. The change of the Snoek peak height, which corresponds to the amount of nitrogen in solution, was analyzed assuming the applicability of the rate equation. As a result of calculation, the order of the reaction was found to be about 2.6, and the activation energy for resolution of nitrogen atoms about 2.9 eV. (auth)

Other Materials

Refer also to abstracts 7581, 8278, 9523, 9657, 9658, 9690, and 9708.

8365 (CEA-R-4473) CONTRIBUTION TO STUDY OF IRRADIATED LITHIUM HYDRIDE: STUDY BY MICRODIFFERENTIAL THERMAL ANALYSIS OF LITHIUM HYDRIDE IRRADIATED AT 52°C WITH ^{60}Co γ RAYS. Barbier, P. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 - Montrouge (France)). Oct 1973. 90p. (In French). Dep. NTIS (U. S. Sales Only) $6.50.

An apparatus for quantitative micro differential thermal analysis (μ. A. T. D.) is described which can operate from 25 to 600°C. The device placed in a dry glovebox is degassed under vacuum up to 130°C. The analyzed samples weigh about 800 μ.g. Thermal effects as small as 5×10^{-5} calorie can be detected (amplitude 1×10^{-3} differential °C). The tests data of μ. A. T. D. and x-rays (rotating - crystal) show the presence of free Li in irradiated LiH. This Li crystallizes in the bcc and fcc structures. The fcc structure is an abnormal phase of Li. The study shows that this last phase is stabilized by the free hydrogen trapped in LiH. (auth)

8366 (CONF-731101-33) THERMAL CONDUCTIVITY OF ORIENTED FIBROUS CARBON INSULATION FROM 300 TO 1300°K IN NITROGEN AND ARGON AT ONE ATMOSPHERE. Godfrey, T. G.; McElroy, D. L.; Ardary, Z. L. (Oak Ridge National Lab., Tenn. (USA)). 1973. 36p. Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The thermal conductivity, λ, of three samples of oriented fibrous carbon insulation was measured from 300 to 1300°K in a radial heat-flow apparatus. Preparation of the 0.18 g/cm^3-density samples by a vacuum filtration process from carbon fibers and powdered phenolic resin, characterization of the material after carbonization, and typical mechanical properties are described. The λ of these low-density composites depended on both the heat-treatment temperature and the fiber orientation. For samples heat treated at 1575°K, the room-temperature λ perpendicular to the planes of fibers was about 0.5 mW $cm^{-1}K^{-1}$ and was three times as high in the direction parallel to the planes. At 1000°K, the λ in both directions had doubled, primarily because of the positive $d\lambda/dT$ of the amorphous carbon fibers. Material heat treated at 2775°K had a significantly higher room-temperature λ and a negative $d\lambda/dT$, indicating that a slight degree of ordering or graphitization had occurred in the fibers during heat treatment. At high temperatures, λ of all three samples increased markedly because of radiative heat transport. (auth)

8367 (N-73-29964) MODIFIED FUSED-SILICIDE COATINGS FOR TANTALUM (Ta–10W) REENTRY HEAT SHIELDS. Final Technical Report, 16 June 1970–15 April 1973. Packer, C. M.; Perkins, R. A. (Lockheed Missiles and Space Co., Palo Alto, Calif. (USA). Research Labs.). 15 Apr 1973. Contract NAS3-14316. 195p. (NASA-CR-120877). NTIS $11.75.

Results are presented of a program of research to develop a reliable, high-performance, fused slurry silicide coating for the Ta–10W alloy. The effort was directed toward developing new and improved formulations for use at 2600 to 2800°F (1700 to

1811°K) in an atmospheric reentry thermal protection system with a 100-mission capability. Based on a thorough characterization of isothermal and cyclic oxidation behavior, bend transition temperatures, room- and elevated-temperature tensile properties, and creep behavior, a 2.5Mn–33Ti–64.5Si coating (designated MTS) provides excellent protection for the Ta–10W alloy in simulated reentry environments. An extensive analysis of the oxidation behavior and characteristics of the MTS coating in terms of fundamental mechanisms also is presented. (auth)

8368 (ORNL-tr-2735) ACTION OF IONIZING RADIATION ON EPOXY RESINS. Van de Voorde, M. E. (European Organization for Nuclear Research, Geneva (Switzerland)). 1970. Translated by M. Gerrard from Sects. 3-6 of CERN-70-10. 49p. Dep. NTIS $4.50.

The resistance of classical and experimental epoxy resins to irradiation was studied. The resistance to irradiation of epoxy resins of diverse compositions as well as the development of resins having a radioresistance that approaches that of certain ceramics are discussed. Sources of irradiation and the techniques of dosimetry used are described. The structures of certain epoxy resins and of hardeners are given. The preparation of these resins and their physical properties is described. The effects of radiation on epoxy resins, as well as conditions of irradiation, and suggested mechanisms for degradation of the irradiated resins are discussed. The relationship between chemical structure of the resins and their physical properties is evaluated. (115 references) (JCB)

8369 (SLA-73-6000) POINT DEFECT SPECTROSCOPY. Balkanski, M.; Da Silva, E.; Nazarewicz, W. Translated by P. Newman from J. Phys. (Paris); 24: 451-457(1963). 21p. Dep. NTIS $3.25.

The absorption spectra of such impurities as oxygen, carbon, and nitrogen are studied in the silicon lattice, and molecular vibrations are obtained at 9, 12.2, and 10.6μ, respectively. High-density defects, created by irradiation with fast neutrons, polarize the lattice and make it possible to observe direct photon–phonon interaction. The infrared absorption spectra due to single phonons are composed of bands at 488, 417, and 331, as well as at 140 cm^{-1}, corresponding to modes TO, LO, LA, and TA, respectively. The energies of TO, for example, are determined under high resolution at the point of maximum density of modes at Γ, L, W, and X. They are 516.5 ± 1; 488.5 ± 1; 474 ± 1, and 447 ± 1. (auth)

8370 (WANL-TME-1664) CHARACTERIZATION OF CARBIDE–GRAPHITE COMPOSITE MATERIAL. First Progress Report. Singleton, R. H (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Oct 1967. Subcontract NP-1. 109p. Dep. NTIS $7.50.

Declassified 30 Aug 1973.

Selected billets of 75 wt % NbC, balance graphite composite materials were characterized with respect to structure, homogeneity, compressive creep deformation, flexural strength, and electrical conductivity. In addition, the effects of variations in the purity and properties of the raw materials, NbC and graphite powders, on these properties were assessed. It was established that an average total 1 hour creep deformation of 4 percent could be expected in the across-grain (AG) direction at 2500°C and 4000 psi with the provision that rigid control be maintained for NbC powder purity and graphite powder characteristics. The apparent activation energy for the creep deformation was approximately 70 kcal/mole. Creep deformation rate was found to be a quadratic function of stress. The exponent, n, in the strain–time relationship, $\dot{\epsilon} = A\,t^n$, was found to be related to stress and temperature. This enables the prediction of creep time curves under varied conditions. The with-grain (WG) creep deformation was approximately 40% greater than the AG creep deformation under the same conditions. Average room-temperature flexural strengths were 13,000 and 9,000 psi in the WG and AG direction, respectively. Variations in the raw-powder characteristic had no effect on room-temperature flexural strength. Flexural strength remained essentially constant to 2500°C. AG compressive strength was approximately 40,000 psi at room temperature and 10,000 psi at 2500°C. Ductility in flexure was limited at 2000°C permitting a maximum permanent bend angle of 2°. At 2500°C, the maximum permanent bend angle increased to 10°. Compressive ductility was above 10% at 2200°C. Room-temperature flexural strength was found to correlate consistently with electrical conductivity, although no direct exponential relationship could be found. (auth)

8371 PROPERTIES OF BORON FIBERS AND BORON–ALUMINUM COMPOSITES UNDER EQUIAXIAL COMPRESSION. Mileyko, S. T.; Sorokin, N. M.; Tsirlin, A. M. (Inst. of Solid State Physics, Moscow). Probl. Prochnosti; No. 6, 41-45(1973). (In Russian).

Experimental data obtained in tests of an aluminum alloy reinforced with boron fibers are presented. Alloy D16 foil had boron fibers pressed into it in a vacuum at high temperature. The lattice spacing of the fibers and thickness of the foil were such that the fibers were positioned in a hexagonal configuration. Samples 6 mm wide were cut on an electric spark machine from plates of the composite material measuring 50 × 100 mm and 0.7 to 2.5 mm thick. Experimental curves of the composite under compression were plotted in order to determine shear strength. Comparison of these graphs with corresponding curves for the matrix material yielded compression curves for the fibers that turned out to be straight lines up to a stress of 1200 kG/mm^2. The optimum volume percentage of fibers in the composite was established ($V_f = 1/3$) for a compression load in the direction of reinforcement. (JPRS)

8372 BRITTLENESS OF COATED TUNGSTEN WIRE. Levinskii, Yu. V.; Treflov, B. F.; Dovychenkova, L. V. (All-Union Scientific Research Inst. of Aviation Materials, Moscow). Probl. Prochnosti; No. 6, 57-59(1973). (In Russian).

The effect of the nature and thickness of specially grown brittle layers on tungsten wire was examined along with their behavior during fracture. The brittle layers were formed by recrystallization or carbonization. A mechanism of brittle fracture of a ductile material is proposed during the transition from a brittle coating to a crack. It is shown that the nature of fracture depends on the plastic properties and thickness of the coating. The produced experimental data correspond qualitatively with the proposed fracture mechanism. (JPRS)

8373 PREPARATION AND PROPERTIES OF A POLYSILOXANE ELECTRON RESIST. Roberts, E. D. (Mullard Research Labs., Surrey, Eng.). J. Electrochem. Soc.; 120: No. 12, 1716-1721(Dec 1973).

The preparation of polymethylcyclosiloxane (PMCS) is described. PMCS may be used as a resist in which siliceous film patterns may be formed by irradiation with an electron beam. These siliceous patterns are readily developed and may be used directly in semiconductor technology as diffusion barriers or as etch-resistant layers, and after suitable heat treatment they may be used also as passivating layers. Transistors were made using PMCS film patterns defined by electron beams as diffusion barriers and as passivating layers. The sensitivity of PMCS to irradiation may be increased by controlled condensation to give a higher molecular weight polymer, or by introducing vinyl groups to replace some of the methyl groups in the polymer. The chemical changes which occur in PMCS upon irradiation by electrons were investigated and it is shown that at doses normally used in making film patterns of use in semiconductor technology, cross-linking occurs mainly through the hydroxyl groups present in the polymer. Subsequent treatment (thermal or radiation) can eliminate organic residues to produce a film which is identical to thermally grown silica. (auth)

8374 DISLOCATION AND RADIATION HARDENING OF NaCl IN SINGLE CRYSTALS. Inabe, K.; Takeuchi, N. (Kanazawa Univ., Japan). Jap. J. Appl. Phys.; 12: No. 6, 947-948(Jun 1973).

An attempt was made to correlate the F band intensity, hardening, and dislocation density. X irradiation was carried out on annealed and reheated-quenched NaCl crystals. Results show slightly increased F-center growth and greatly suppressed Vickers hardness for the reheated-quenched samples compared to annealed samples, thus indicating that the variation of hardness with F center density decreases with increased dislocation density. This may be explained if the interstitials produced by the irradiation are attracted to dislocations, forming larger and fewer clusters. (DLC)

8375 NEW FAMILY OF POSITIVE ELECTRON BEAM RESISTS: POLY(OLEFIN SULFONES). Thompson, L. F.; Bowden, M. J. (Bell Telephone Labs., Inc., Murray Hill, NJ). J. Electrochem. Soc.; 120: No. 12, 1722-1726(Dec 1973).

Poly(olefin sulfones) are shown to represent a new class of positive electron beam resists exhibiting sensitivities in the region of 1.3×10^{-4} coulombs cm^{-2}. Processing variables are evaluated and exposure characteristics determined. These materials can be used in two development modes, (i) as a conventional solvent-developed system and (ii) as a system which self develops during electron-beam irradiation by depolymerization followed by vaporization. Limitations of this "vapor development" process are discussed. 6 figures. (auth)

8376 X-RAY STRUCTURAL DAMAGE OF TRIGLYCINE SULPHATE (TGS). Alemany, C.; Mendiola, J.; Jimenez, B.; Maurer, E. (Centro de Investigaciones Fisicas L. Torres Quevedo, Madrid). Acta Crystallogr., Sect. A; 29: No. 4, 423-427(1 Jul 1973).

The complete spectrum emitted by a conventional x-ray diffraction Cu target produces damage in a small TGS crystal which is evident from the variation of integrated intensities of x-ray reflexions with irradiation time. An interpretation of the data is proposed which assumes that the trapping of irradiation products causes an exponential decrease of mosaic-block diameters. An empirical correction of the Zachariasen extinction factor for crystals belonging to Type II is suggested, since the TGS crystal is of this type. (auth)

8377 OPTICAL ABSORPTION AND LUMINESCENCE OF N-IRRADIATED KBr. Choundry, A.; Mitra, S. S. (Univ. of Rhode Island, Kingston). Solid State Commun.; 13: No. 10, 1689-1691 (15 Nov 1973).

About ten minutes after reactor pneumatic tube irradiation (10 to 50 sec) of KBr samples, optical absorption and luminescence were studied during heating–cooling cycles. The induced radioactivity acting as an internal source of irradiation is found to play a dominant role and is responsible for some anomalous results. (auth)

8378 OPTICAL PROPERTIES OF POSITIVE HOLE CENTRES OBTAINED IN X-IRRADIATED $SrCl_2$ DOPED WITH AN ALKALINE CATION. Rzepka, E.; Mitroaica, G.; Lefrant, S.; Taurel, L. (Paris Univ., Orsay, France). Solid State Commun.; 13: No. 9, 1499-1501(1 Nov 1973).

The optical absorption spectra and thermoluminescence curves can be accounted for with the assumption that, at liquid helium temperatures, there exist pure V_k centers which, by warming, are converted gradually to perturbed V_k centers. The transformation is complete at 130°K. (auth)

8379 DEFORMATION AND TWINNING OF GRAPHITE CRYSTALS UNDER A POINT LOAD. Skinner, J.; Gane, N. (Cambridge Univ., Eng.). Phil. Mag.; 28: No. 4, 827-837(Oct 1973).

The deformation produced by point loading on the cleaved basal surfaces of graphite crystals was studied in the scanning electron microscope. The experiments were of two types, viz. sliding and static contact. In the first, a small tungsten stylus (tip radius ~1 μm) was slid on the graphite surface inside the scanning electron microscope and the resulting damage observed as it occurred. The marked anisotropy and the limited number of slip systems of the graphite structure result in a characteristic deformation mode that involves the cleavage of thin flakes followed by folding of the partially separated layers. In the second type of experiment, the deformation produced by a diamond indenter was studied. These experiments showed that the hardness value of c. 4.8×10^7 N/m^2 for naturally-occurring graphite and 22×10^7 N/m^2 for neutron-irradiated graphite are determined by a cleavage and folding process and are not related to the basal-plane shear strength. It is suggested that the mechanism of folding in both types of experiment is one of mechanical twinning. An important feature of the deformation process is that the dislocation walls forming the twin boundaries are mobile under the applied stress and are free to run in the newly formed chips and flakes in a direction parallel to the basal plane. The greatly increased hardness of neutron-irradiated graphite is explained by the reduction in mobility of the twin boundaries due to the high point defect concentration. (auth)

8380 POSSIBLE ORIGINS OF α DAMAGE IN DIAMONDS FROM KIMBERLITE AND ALLUVIAL SOURCES. Vance, E. R.; Harris, J. W.; Milledge, H. J. (University Coll., London). Mineral. Mag.; 39: No. 303, 349-360(Sep 1973).

Heating experiments provide strong evidence that the transparent green coats on some diamonds from each of many localities are caused by α-particle irradiation after kimberlite injection and subsequent cooling. The natural diamonds with more or less homogeneous transparent green coats, studied in this work, appear to have received doses of at least 5×10^{13} to 1×10^{14} α·cm^2. For pre-Cambrian kimberlites, such doses could occur if certain regions of the diatremes contained ≥20 ppM by weight of equivalent uranium, after kimberlite injection and solidification. Such considerations lead to the prediction that the radioelement concentrations in the Finsch kimberlite diatreme and the Bellsbank fissure kimberlite are considerably greater than those in the Premier mine, though radioelement segregation could produce the required local concentrations. Some exploratory autoradiographic measurements made on two kimberlite rock samples from Premier and De Beers Mines indicated that the radioelements were apparently distributed on a submicron scale, which would be a necessary, but not sufficient, condition for uniform α-irradiation of diamonds. Diamonds from various alluvial sources showing green and brown spots arising from much heavier and more localized radiation damage are also discussed. (auth)

8381 POSSIBLE MAGNETIC SPACE GROUP OF UI_3. Dayanidhi, K. K. (Andhra Univ., Guntur, India). Indian J. Pure Appl. Phys.; 11: No. 5, 359-360(May 1973).

The magnetic space group of antiferromagnetic UI_3 is derived theoretically on the basis of its chemical structure and measured magnetic field magnitudes. The characteristics of the space group assigned, viz. $P_C mc2_1 = C_P mc2_1$, are discussed. (auth)

8382 EFFECT OF DEGREE OF GRAPHITIZATION ON GALVANOMAGNETIC EFFECTS DURING NEUTRON IRRADIATION. Polozhikhin, A. I.; Virgil'ev, Yu. S.; Kotosonov, A. S.; Efremova, G. F.; Kalyagina, I. P. At. Energ. (USSR); 35: No. 3, 207-208(Sep 1973). (In Russian).

With increasing graphitization of carbon, the magnetic resistance increased, the sign of the Hall coefficient changed from positive to negative, and the electrical resistance decreased. Irradiation of the samples caused amorphization, with a decrease in the crystallite dimensions and 6 to 7% increase in the interlayer distance. The electrical resistance of well-graphitized samples abruptly increased upon irradiation, while in poorly graphitized samples it decreased due to an increase in the charge carrier concentration and to changes in the other properties that determine the resistance. The magnetic resistance of irradiated samples decreased to zero and the Hall coefficient became positive. The Hall coefficient on irradiated samples did not depend on the temperature (77 and 300°K). Excess "vacancies" caused by the irradiation decreased with increase in the degree of development of the structure. (TTT)

8383 ION IMPLANTATION: MEASUREMENT OF ION PRESSURE. Hlavka, J. (Purkyne Univ., Brno). Phys. Lett.; 45A: No. 5, 407-408(22 Oct 1973).

A simple technique of measurement of ion pressure which is created when accelerated ions strike a solid target is described. The apparatus uses a piezoelectric pickup. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

8384 (LA-UR-73-1585) CHEMICAL ASSAY OF PLUTONIUM FOR SAFEGUARDS. Jackson, D. D.; Rein, J. E.; Waterbury, G. R. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. 19p. (CONF-731101-20). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The plutonium-containing samples analyzed for nuclear safeguards purposes range from heterogeneous scrap materials to highly pure metal. The factors governing the selection of analytical methods are the quantities of plutonium represented by the sample and the representativeness of the sample. Product-type materials generally are characterized by high plutonium contents and homogeneity whereas scrap-type materials usually have low plutonium contents and are heterogeneous. Analytical methods that provide highly reliable measurements therefore are used for product materials and less reliable methods are acceptable for scrap materials. Analytical methodology used for plutonium assay for various nuclear fuel cycle materials with emphasis on Los Alamos Scientific Laboratory (LASL) practices is discussed. A major portion of this presentation is devoted to a system under development for scrap-type samples which involves a combination of high-temperature, pressurized, acid-dissolution attack; a gamma assay for low levels of plutonium in any resulting residue; and use of an automated spectrophotometer for measuring plutonium in the solubilized fraction. The isotopic analysis of plutonium is briefly discussed. Also, the status of physical standards for assay and isotopic measurement applications is reviewed. (auth)

8385 (LA-UR-73-1595) NONDESTRUCTIVE ASSAY OF FISSILE MATERIAL SAMPLES IN SUPPORT OF NUCLEAR SAFEGUARDS. Evans, A. E. Jr. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 10p. (CONF-731112-1). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

Samples of fissile material can be assayed by bombarding with 300- to 600-keV neutrons and counting delayed neutrons from fission. Interrogating neutron energy selection is based upon considerations of sample penetrability and insensitivity of response to nonfissile isotopes. Significant cost savings in nuclear safeguards and quality control are possible. (auth)

8386 (REG/G-5.13(1/73)) CONDUCT OF NUCLEAR MATERIAL PHYSICAL INVENTORIES. (USAEC Directorate of Regulatory Operations, Washington, D.C.). Nov 1973. 13p.

Part 70 of Title 10 of the Code of Federal Regulations requires licensees authorized to possess more than 350 g of contained ^{235}U, ^{233}U, or Pu to conduct a physical inventory of all special nuclear material in his possession at intervals not to exceed 12 months. Licensees authorized to possess more than one effective kilogram of special nuclear material are required to conduct measured physical inventories of their special nuclear materials more frequently than annually depending on the materials. Further, these licensees are required to conduct their nuclear material physical inventories in compliance with specific requirements set forth in Part 70. Licensees possessing material for use in the operation of a nuclear reactor, as sealed sources, or as reactor-irradiated fuels involved in research, development, and evaluation programs in facilities other than irradiated fuel reprocessing plants are exempted from these latter requirements. This guide describes measured physical inventory procedures which are acceptable to the Regulatory staff with respect to compliance with the physical inventory requirements set forth in 10 CFR Part 70. (auth)

8387 (REG/G/5.14-(11-73)) VISUAL SURVEILLANCE OF INDIVIDUALS IN MATERIAL ACCESS AREAS. (USAEC Directorate of Regulatory Operations, Washington, D.C.). Nov 1973. 7p.

This guide describes operational measures and physical features which the AEC Regulatory staff considers to be adequate for the implementation of visual surveillance of individuals within material access areas to assure that special nuclear material is not diverted from its intended use. (TFD)

Disposal and Storage

Refer also to abstracts 7623–7634, 7638, 7640, 7646–7649, 7699–7701, and 9405.

8388 (AECL-4510) RETENTION OF RADIONUCLIDES DEPOSITED IN THE CHALK RIVER NUCLEAR LABORATORIES WASTE MANAGEMENT AREAS. Merritt, W. F.; Mawson, C. A. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Sep 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00. AECL $0.50.

Records are presented of the amounts of radionuclides deposited in engineered enclosures and directly into the ground in the waste management areas at the Chalk River Nuclear Laboratories up to the end of 1972. About 5.2 MCi of long-lived radionuclides, mainly in the form of stored reactor fuel, have been placed in engineered facilities and about 32 kCi have been deposited directly into the ground. Any radionuclides escaping into public waters from this system must pass down Perch Creek into the Ottawa River. The total run-off down Perch Creek over the whole period was 13 Ci. The Chalk River site has therefore proved to be very effective in retaining radionuclides in spite of the low ion-exchange capacity of the soil and conditions of climate and water table height that make it less than ideal for radioactive waste management. It is hoped that this information will be useful in planning future waste management operations. (auth)

8389 (ARH-SA-165) DURABILITY EVALUATION OF RADIOACTIVE WASTE PRODUCTS. Brownell, L. E.; Isaacson, R. E.; Ogren, W. E. (Atlantic Richfield Hanford Co., Richland, Wash. (USA)). 1 Nov 1973. 19p. (CONF-731101-25). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

8390 (CONF-721107-) MANAGEMENT OF RADIOACTIVE WASTES FROM FUEL REPROCESSING. Proceedings of Symposium, Paris, November 27–December 1, 1972. (Organization for Economic Co-Operation and Development, Paris (France); International Atomic Energy Agency, Vienna (Austria)). Mar 1973. 1266p. (In French and English). OECD, Washington, D. C. $34.00.

Forty-seven papers were presented. A separate abstract was prepared for each of 45. Two papers were previously abstracted in NSA. For abstracts of these see CONF-721107– in the Report Number Index. (LCL)

For abstracts of individual papers see: 7623–7635, 7646–7651, 7698, 7699, and 8391–8414.

8391 (CONF-721107-, pp 15-36) NUCLEAR FUEL CYCLE AND WASTE PRODUCTION. Rubin, J. H. (Atomic Energy Commission, Washington, DC). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The main elements of the slightly enriched water-cooled reactor fuel cycle are described. Included are the operations of mining and milling, chemical conversion, isotopic enrichment, fuel fabrication, reactor operation, and chemical reprocessing. The nature of the radioactive wastes generated in the various steps of the fuel cycle are characterized. These include mill tailings, low-level solid wastes, high-level wastes, and low-level wastes containing plutonium and other actinides. Techniques for managing wastes, based on the present level of technology, as well as a view toward possible future alternatives are presented. (auth)

8392 (CONF-721107-, pp 55-75) FORECASTING OF RADIOACTIVE WASTES ARISING FROM NUCLEAR FUEL REPROCESSING. Martin, A.; Apsimon, H. (Associated Nuclear Services, London). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

A mathematical model has been developed to represent the generation and subsequent movements of radionuclides arising in a nuclear power program. This model has been written into a computer program, NIMROD, by means of which estimates may be obtained of the inventories and throughputs of radionuclides in nuclear installations, including reprocessing plants and storage facilities. The operation and application of the model are illustrated by results obtained on the basis of a recent forecast of the nuclear power program in the UK up to the year 2000 A.D. Present results indicate that the quantities of long-lived radioactive wastes resulting from the reprocessing of fast reactor fuel will not be markedly greater than those from current types of thermal reactors. (auth)

8393 (CONF-721107-, pp 77-98) OFF-GAS TREATMENT AND KRYPTON DISPOSAL IN HTGR-FUEL ELEMENT REPROCESSING. Laser, M.; Beaujean, H.; Bohnenstingl, J.; Filss, P.; Heidendael, M.; Mastera, S.; Merz, E.; Vygen, H. (Kernforschungsanlage, Juelich, Ger.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Krypton, tritium, and iodine are separated from burner off-gas by CO_2-liquefaction and rectification at room temperature. Krypton is concentrated in the lower boiling fraction, while tritium and iodine are concentrated in the higher boiling fraction (AKUT-process). The dissolver off-gas is decontaminated by a cryogenic process. Based on safety and economy, the disposal of compressed krypton confined in steel cylinders by dumping in the deep sea is preferred to the long term overground bunker storage. The estimated costs are: 1.3×10^{-3} Dpf/kWh for cleaning the burner off-gas; 1×10^{-4} Dpf/kWh for dissolver off-gas cleanup; 2.8×10^{-5} Dpf/kWh for krypton disposal into the deep sea, and 2.4×10^{-4} Dpf/kWh for the long term overground krypton storage. (auth)

8394 (CONF-721107-, pp 181-198) SAFETY PRINCIPLES IN THE STORAGE OF FISSION PRODUCTS. Sousselier, Y. (CEA, Paris). Mar 1973. (In French).

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The solutions to be adopted in the storage of fission products arise on the one hand from their activity and on the other from principles aiming at assuring that the storage will not involve any risk or inconvenience for future generations. The examination of the radiological harmfulness of the different constituents of fission products makes it possible to show that a decontamination factor of 10^3 to 10^4 is necessary to reduce the noxiousness of alpha emitters to a value compatible with a storage near the surface of the soil and that that ought to be guaranteed for a period of 800 y. The other possibility is storage in a salt formation or in a deep geologic formation. Among the latter type, storage in a granite formation seems able to present particular interest because it would often permit storage under the site of reprocessing plants and would avoid the transportation of the fission products. An important element in putting a safe policy of storage into effect is the financial aspect. It is indispensable to provide for a means of solidification and final storage of the fission products. (tr-auth)

8395 (CONF-721107-, pp 199-231) TREATMENT AND FINAL DISPOSAL OF RADIOACTIVE WASTES FROM FUEL REPROCESSING IN THE FEDERAL REPUBLIC OF GERMANY. A Survey on Policy and R + D Work. Krause, H. (Kernforschungszentrum, Karlsruhe, Ger.); Randl, R. Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

In the Federal Republic of Germany the high-level wastes (HLW) will be solidified after a limited interim storage as liquids and the solidified residues will be disposed of in a salt mine. At the Karlsruhe Nuclear Research Center the solidification of HLW from the reprocessing of light water fuels has been studied. An inactive pilot plant is in operation. The corresponding hot cell facility (VERA) is under construction. Its particular layout allows also testing of advanced processes and products being developed now. (auth)

8396 (CONF-721107-, pp 233-258) HIGH LEVEL RADIOACTIVE WASTE MANAGEMENT IN THE UNITED KINGDOM. Clelland, D. W. (British Nuclear Fuels Ltd., Risley, Eng.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

An estimate is made of the amount of future high-level radioactive liquid waste which will arise from the UK nuclear power program. The present waste management philosophy is outlined and the existing liquid storage system is described. The problems of introducing a solidification system and a more permanent form of storage for the longer term are discussed. (auth)

8397 (CONF-721107-, pp 259-274) TECHNICAL AND ECONOMIC ASPECTS OF HANDLING INTERMEDIATE- AND HIGH-ACTIVITY LIQUID WASTES. Spitzyn, V. I.; Khonikevich, A. A.; Balukova, V. D.; Nosova, L. M.; Rakov, N. A. (State Committee on the Utilization of Atomic Energy, Moscow). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The problems of handling intermediate- and high-level liquid wastes obtained during the reprocessing of fuel elements from water-water power reactors are discussed. Data on the chemical and radiochemical composition of these wastes are presented. When the waste is highly radioactive, it is advisable to extract strontium and cesium, and possibly other isotopes. For the part remaining after extraction, the following handling procedures are considered: prolonged storage in special tanks in order to reduce the overall activity of the fission products contained in the waste; incorporation of high-level wastes in solids by one of the well-known methods tested in pilot plants; and burial of high-level wastes in water-bearing geological horizons—similar to the underground burial of intermediate-level wastes as practiced in the USSR. Since, in the last procedure, the greatest hazard is likely to result from a concentration of fission products in the ground, with resultant releases of gas and heat by radiative processes, particularly careful attention is given to the preparation of high-level wastes for burial underground. This consists either in removing clogging substances from the waste or in converting them to complex compounds which will be stable in the conditions of the formation where the waste is to be buried. Some calculated technical and economic data on the storage of high-level liquid wastes and on the underground burial of intermediate and high-level wastes are presented. These methods are compared with other methods of storage and processing of radioactive wastes. (auth)

8398 (CONF-721107-, pp 275-284) PLANNING FOR THE MANAGEMENT OF RADIOACTIVE WASTE FROM REPROCESSING OF FUEL IN AEC PROGRAMS. Trice, V. G. Jr.; Walton, R. D. Jr. (Atomic Energy Commission, Washington, DC). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The first edition of the Plan for the Management of the AEC's Waste (WASH-1202) was published in January 1972. The reasons for the Plan, the procedures used in its preparation, its role in the definition, scheduling, and funding of waste management activities, and the provisions for updating the Plan periodically are discussed. (auth)

8399 (CONF-721107-, pp 285-295) PLANS FOR THE MANAGEMENT OF RADIOACTIVE WASTE FROM REPROCESSING FUEL IN COMMERCIAL OPERATIONS. Perge, A. F.; Ramsey, R. W. Jr. (Atomic Energy Commission, Washington, DC). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The magnitude of the commercial reprocessing waste business is estimated and plans of the United States Atomic Energy Commission (AEC) are discussed in four areas: AEC policies governing the management of the waste prior to transfer to a Federal Repository; plans for construction of Federal Repositories; research and development on waste treatments; and evaluation of advanced concepts for long-term storage or disposal to determine which are worthy of further development. (auth)

8400 (CONF-721107-, pp 299-312) MANAGEMENT OF FUEL REPROCESSING WASTES IN JAPAN. Nakajima, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

PNC (the Power Reactor and Nuclear Fuel Development Corp.) in Japan is proceeding with a plan to have a fuel reprocessing plant in operation by 1975. The equipment to be used during the first five years for treating highly radioactive liquid waste and the philosophy of long-term storage, including waste solidification, are described. Methods for treating ^{85}Kr and tritium arising from fuel reprocessing in the PNC plant are discussed. Approaches to proposed research on Kr recovery, high-level liquid waste solidification, and long-term waste storage are also presented. (auth)

8401 (CONF-721107-, pp 339-355) OPERATIONAL EXPERIENCE IN THE EVAPORATION AND STORAGE OF HIGHLY ACTIVE FISSION-PRODUCT WASTES AT WINDSCALE. Warner, B. F.; Davidson, A. S.; Larkin, M. J.; Naylor, A. (British Nuclear Fuels Ltd., Seascale, Eng.). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The design, operation, and performance of evaporators and a storage tank used for the concentration and storage of highly radioactive fission product waste from the Windscale reprocessing plants are discussed. Experience to date indicates that currently designed equipment is simple and reliable and can be used as a design basis for future equipment for the safe and economical storage of highly active waste. (LCL)

8402 (CONF-721107-, pp 357-407) MANAGEMENT OF RADIOACTIVE AQUEOUS WASTES FROM U. S. ATOMIC ENERGY COMMISSION'S FUEL REPROCESSING OPERATIONS, EXPERIENCE, AND PLANNING. Lennemann, W. L. (Atomic Energy Commission, Washington, DC). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Since 1944, the U. S. AEC (and its predecessor, the Manhattan Engineering District) has been overseeing the management of

radioactive wastes from its fuel reprocessing plants which are contractor operated. Experience during the years has indicated that management of radioactive wastes from fuel reprocessing requires unrelenting evaluation and appraisal by higher management and management groups. Important related activities are periodic reviews, frequent analyses, and continuous planning. Suggested guidance for fuel reprocessing waste management systems include such features as acid waste storage, double containment, protection against credible forces of nature, facilities for emptying waste storage tanks, space and accesses for inspection, adequate radiation monitoring devices connected to a central recording station, and segregation and diversion capability for discharged effluent aqueous streams. (auth)

8403 (CONF-721107-, pp 409-429) LONG-TERM WASTE MANAGEMENT METHODS. Platt, A. M. (Battelle Pacific Northwest Labs., Richland, WA); Ramsey, R. W. Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Battelle-Northwest has been conducting extensive evaluations of permanent or ultimate methods for storage and/or disposal of high-level radioactive wastes. Included are use of extraterrestrial transport, transmutation, cavities deep in the earth, the sea bed including use of tectonic subsidence areas, and various combinations of geological and engineered structures. A large number of factors can influence the selection of new methods for the long-term management of radioactive wastes. Because of the sketchy knowledge of these factors at this time, the initial studies have focused on feasibility, timing, and safety. The methodology being used to study these subjects is reported. Specific information is presented on the potential usefulness of transmutation, extraterrestrial disposal and polar ice for management of nuclear wastes. The requirements of each option for modification in methods of reprocessing or subsequent waste treatment are discussed. (auth)

8404 (CONF-721107-, pp 431-446) PROPOSAL FOR THE ESTABLISHMENT OF A PERMANENT INTERNATIONAL HIGH-LEVEL RADIOACTIVE WASTE DEPOSITORY IN ANTARCTICA. Zeller, E. J.; Saunders, D. F.; Angino, E. E. Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The feasibility of using the Antarctic ice-cap for the permanent disposal of radioactive wastes which have been fused into a solid glass matrix is discussed. The plan is to place the waste containers on the ice surface and to allow the heat of the containers to melt emplacement shafts through which the containers will sink to the ice-rock interface for permanent storage. The emplacement shafts would rapidly reseal themselves by plastic flow and freezing. The legal requirements for amending the Antarctica Treaty of 1959 which forbids radioactive waste disposal in the region, the technical data required for establishing the feasibility of this waste disposal system, and the desirability of conducting an experiment under the supervision of an international agency to evaluate the method are discussed briefly. (LCL)

8405 (CONF-721107-, pp 813-846) DESIGN OF AN INDUSTRIAL FACILITY FOR THE INCORPORATION INTO GLASS OF FISSION PRODUCTS AND THE STORAGE OF HIGHLY RADIOACTIVE GLASS. Giraud, J. P.; Le Blaye, G. (Saint-Gobain Techniques Nouvelles, Courbevoie, France). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

An industrial facility is described for incorporating fission products into glass (or vitrification) that was designed to be adapted for use in a plant treating LWR type radioactive wastes. The main basic hypotheses and the principal stages of the process are defined. A description is given of the arrangements made for the temporary storage of the fission product solutions, the unit for the actual vitrification of the fission products, the treatment of gaseous and ruthenium effluents, the temporary storage of the glass on the site, and the utilities. The released activities are given and an analysis is made of the design of the facility from the safety point of view. Finally, a brief indication of the investment cost is given and an analysis is made of the possible applications of the process, with emphasis on its contribution to solving the safety problems involved in the temporary or long-term storage of highly radioactive wastes. (auth)

8406 (CONF-721107-, pp 847-861) TECHNICAL AND ECONOMIC COMPARISON OF METHODS FOR SOLIDIFYING AND STORING HIGH-ACTIVITY LIQUID WASTE ARISING IN THE REPROCESSING OF IRRADIATED FUEL ELEMENTS FROM WATER-COOLED AND WATER-MODERATED REACTORS. Azamaeva, L. G.; Ilina, Z. G.; Kolosov, A. N.; Kondratiev, A. N.; Khodos, M. A.; Khonikevich, A. A. (State Committee on the Utilization of Atomic Energy, Moscow). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

In the Soviet Union work on the vitrification of high-level radioactive solutions is being pursued in two directions, one involving the use of a two-stage process and the other a single-stage process. In the two-stage process, drying and calcining are performed in a fluidized bed apparatus while the conversion of the calcined product to glass takes place in a disposable concrete or ceramic crucible (single application), in which it is then sent to the burial ground for storage; in the single-stage process, drying, calcining and melting are all performed in the same apparatus. The glass melt is poured directly from the apparatus into the burial ground, situated beneath it, or into a special container, which is then transported to a burial ground. Both processes have been used in tests with model solutions on experimental-industrial installations with a throughput of 50 to 100 l/hr, referred to the initial unfluxed solution. In the course of these tests the main technological parameters were obtained, the performance of the basic equipment and the gas purification system was checked and data were obtained for a planned experimental-industrial installation. The specific capital costs, the operating costs and the optimal conditions for long-term storage of the vitrified mass in special burial grounds were determined on the basis of technical and economic calculations. In addition, a comparative study is made of the technical and economic characteristics of an optimal variant of the vitrification method in which high-level wastes are stored as solutions in stainless steel containers provided with coil pipes for heat removal. (auth)

8407 (CONF-721107-, pp 863-872) ECONOMIC EVALUATION OF PROCEDURES FOR STORING HIGH-ACTIVITY EFFLUENTS FROM FUELS FROM FAST NEUTRON REACTORS. Bendell, F.; Bonniaud, R.; Michel, P.; Rozand, L. (CEA, Paris). Mar 1973. (In French).

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The storage of high-level liquid wastes either as liquids which have or have not been subjected to concentration and prestorage or in the form of glasses following vitrification prior to prestorage is discussed. These processes are compared on the basis of their cost considering both the actual investment costs and development costs. It is shown that there is no large variation in cost between the two processes and that the economics of storage is not a criterion of choice. (tr-auth)

8408 (CONF-721107-, pp 873-884) ACTIVITIES OF THE GEOLOGICAL SURVEY, UNITED STATES DEPARTMENT OF THE INTERIOR, IN THE SEARCH FOR A GEOLOGIC ENVIRONMENT SUITABLE FOR THE MANAGEMENT OF HIGH-LEVEL RADIOACTIVE WASTE. DeBuchananne, G. D. (Geological Survey, Washington, DC). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

The Geological Survey has cooperated with the USAEC in evaluating the potential of different geologic and hydrologic environments for the management of radioactive waste. Studies, during the past 20 years, have included development of techniques on subsurface monitoring of proposed waste management areas, geochemical and geophysical problems related to the compatibility of waste products to the hydrogeological environment and consideration of catastrophic forces that could adversely affect waste containment. (auth)

8409 (CONF-721107-, pp 887-916) UTILIZATION OF CLAY FORMATIONS FOR STORAGE OF SOLID HIGH-LEVEL RADIOACTIVE WASTES. Ferro, C.; Giannotti, G. P.; Mittempergher, M.; Musy, D.; Sidoti, G.; Stampone, E.; Vallone, C. (CNEN, Rome). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

Some clay formations, which represent a valid alternative to salt formations as a geological environment to be used for the storage of solid high level radioactive wastes, were investigated. This study was carried out in an area where a clay formation, mainly composed of illite, chlorite, kaolinite, montmorillonite and detrital minerals, reaches a thickness of about 700 to 800 m and outcrops, under stable conditions, at an altitude near sea level. The vertical and horizontal homogeneity of the clay formation were ascertained by bore holes. The absence of circulating water was ascertained by radioactive tracers. Geotechnical tests carried out in the laboratory showed the deformation characteristics of the clay formation. The low migration in the clay formation of radioactive elements occurring in the wastes was demonstrated by several radioactive tracers. The theoretical behavior of the isothermal lines, in transient state of a cylindrical heat source in a homogeneous semi-infinite medium, was determined. This research has demonstrated that some types of stable clay formations

can be considered as a suitable natural environment for the storage of solid high level radioactive wastes. (auth)

8410 (CONF-721107-, pp 917-932) DISPOSAL OF SOLIDIFIED HIGH-LEVEL RADIOACTIVE WASTES IN THE ASSE SALT MINE. Kuehn, K. (Gesellschaft fuer Strahlenund Umweltforschung mbH, Munich); Diefenbacher, W.; Krause, H.; Schmidt, H. Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

A critical review of the German policy confirmed the feasibility of disposing of solidified high-level radioactive wastes in the Asse Salt Mine. From the respective R & D-program some important geological data, some results of computer calculations and field experiments on heat dissipation, and the general idea of the transport and handling system are presented. (auth)

8411 (CONF-721107-, pp 933-952) PLACEMENT AND SELF-PROCESSING OF NUCLEAR FUEL REPROCESSING WASTES IN DEEP UNDERGROUND CAVITIES. Lewis, A. E.; Cohen, J. J.; Braun, R. L.; Rothman, A. J. (Univ. of California, Livermore). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

A method is presented for disposing of nuclear fuel reprocessing wastes by in situ incorporation in molten silicate rock. In this method, liquid wastes are injected into a deep underground cavity and allowed to self-boil. The resulting steam is processed at the ground surface and recycled in a closed system. When waste addition is terminated, the chimney is allowed to boil dry, thereby solidifying the waste. The heat generated by the radioactive waste then melts the surrounding rock, which dissolves the waste. Finally, the rock refreezes, trapping the radioactivity in an insoluble rock matrix deep underground. This method has significant environmental and economic advantages over previously proposed methods. (auth)

8412 (CONF-721107-, pp 987-1001) PHYSICAL AND CHEMICAL FACTORS GOVERNING THE DISPOSAL OF HIGH-ACTIVITY LIQUID WASTE INTO DEEP GEOLOGICAL FORMATIONS. Spitsyn, V. I.; Balukova, V. D.; Yudin, F. P.; Pimenov, M. K. (State Committee on the Utilization of Atomic Energy, Moscow). Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

A study of the thermal field of a formation after the injection of radioactive wastes shows that there is a limiting activity, above which the injection of waste into the ground is not permissible; this limit is determined by specific geological and hydrogeological conditions such as the thickness of the formation, the mineralogical and lithological composition of the rock in the absorbing layers, and various other factors. The main limiting factor is the temperature to which the stratum is heated in the injection region; this temperature should not exceed the boiling point of the water in the formation at the prevailing pressure. Since the heating of the formation is a direct function of the concentration of radioisotopes in the injection region (both in the liquid waste and in the solid material of the formation), one of the essentials in evaluating the possibility of burying high-level wastes is to study the distribution of radioisotopes in the material of the formation; this factor also affects the secondary processes, such as heat release and radiolysis accompanying the liberation of gas. The conditions under which the main long-lived isotopes accumulate in the different types of rock constituting the reservoir formations are considered. Data are given on the rates and levels of isotope accumulation for wastes of different chemical composition and for different seepage rates. The possibility of prior chemical treatment of the injection zone for the purpose of controlling the accumulation of radioisotopes in the formation material is discussed. Ways in which transition zones (fringe zones) are formed as a result of using different buffer solutions are described. Results are presented of thermal and physical calculations on the heating of the injection region in the case of different accumulations of radioisotopes in the ground. On the basis of studies and calculations performed with the aid of a computer, conditions under which high-level wastes can be buried in deep geological formations without radiation hazard are formulated. (auth)

8413 (CONF-721107-, pp 1003-1030) DEEP-WELL DISPOSAL OF TRITIUM-CONTAINING LIQUID EFFLUENTS. Hild, W. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.); Krause, H.; Sauer, K.; Kessler, W.; Fischak, W. Mar 1973.

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

At the Karlsruhe Nuclear Research Center deep-well injection of tritium-containing effluents into isolated depleted oil horizons of the deep underground is being studied as an approach of tritium disposal, which does not lead to a pollution of the biosphere. The geology of the oil field in the vicinity of the Center, the technical underground and surface adaptations of the selected well, the control and surveillance provisions are described together with the essential safety considerations and the anticipated operation conditions. (auth)

8414 (CONF-721107-, pp 1133-1155) DECOMMISSIONING OF REPROCESSING PLANTS: RESULTS OF PRELIMINARY STUDIES RELATIVE TO EUROCHEMIC INSTALLATIONS. Detilleux, E. (EUROCHEMIC, Mol, Belg.). Mar 1973. (In French).

From symposium on the management of radioactive wastes from fuel reprocessing; Paris, France (27 Nov 1972).

A study of the technical problems related to the possible closing down of the Eurochemic reprocessing installations serves as a basis for the analysis presented. After a brief description of the principal installations to be dismantled, the state of dismantling to be attained is discussed. This is related to local conditions and to the nature of future activities required at the site. These considerations have led to envisaging the total disassembling of the Eurochemic installations and the transportation of wastes away from the site for final storage. The steps for decontamination and dismantling are discussed and some calculations are presented which indicate the extent of the undertaking. The numerous unknowns remaining in the evaluation of the work, as well as the uncertainties relative to the final disposition of the solid wastes resulting from dismantling, do not permit giving a cost estimate for the enterprise. (tr-auth)

8415 (DP-MS-73-41) LIGHT-WATER-MODERATED REACTIVITY OF TUBULAR SLUG PAIRS CONTAINING 1.1 WT % ^{235}U. Smotrel, J. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 19p. (CONF-731101-42). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Experiments in the exponential facility at the Savannah River Laboratory have provided a basis for safe storage and handling of slightly enriched tubular uranium slugs. The reactivities of light-water-moderated and reflected arrays of clustered fuel slugs enriched to 1.1 wt % ^{235}U were measured as a function of pitch, both square and triangular. This work represents an expansion of nuclear safety data presently available by providing new data on larger and concentric tubular assemblies. These data can be used to extend experimental correlations of calculational codes. (auth)

8416 (LA-5451-PR) TRANSURANIC WASTE RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY REPORT, MARCH–JUNE 1973 AND TRANSURANIC CONTAMINATED SOLID WASTE TREATMENT PROGRAM ANNUAL REPORT, FY 1973. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 36p. Dep. NTIS $4.00.

Progress during the period of March–June 1973 for the Transuranic Solid Waste Research and Development Program and for FY 1973 for the Transuranic Contaminated Solid Waste Treatment Program is reported. All of the solid waste management activities at LASL have been consolidated into one group, and research and development activities will now be reported in a single quarterly report. During this period, the Criteria for the Interim Storage of AEC-Generated Transuranic Wastes have progressed to a rough draft stage with initial review by DWMT. The experimental programs on corrosion, radiolysis, combustion, and leaching, designed to provide data for the criteria and for optimization of the storage procedures, have continued. The Conceptual Design Report for the Waste Volume Reduction Development Facility neared completion at the end of the year. Preliminary studies were made in evaluating the progress of the candidate processes to be used in this facility. These processes include incineration, molten salt combustion, pyrolysis, pressurized oxygen combustion, and acid digestion, all of which are under study by various laboratories of the AEC or commercial operations. (auth)

8417 (MLM-2087(OP)) NEW APPROACH TO TRITIUM LEAK RATE DETERMINATION. Sheehan, W. E.; Curtis, M. L. (Mound Lab., Miamisburg, Ohio (USA)). 1973. 10p. (CONF-731112-8). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

A method for determining leak rates (on the order of 1×10^{-17} cm^3/sec and higher) from containers of tritium waste is described. Each container is sealed in a disposable can. After several days, the accumulated tritium is flushed from the can with compressed air through an ethylene glycol bubbler where the HTO, but not the tritium, is trapped. The output of the bubbler is channeled through a heated palladium catalyst where the HT is oxidized. The oxidized

tritium is collected in a second ethylene glycol bubbler. The tritium collected in both bubblers is measured by liquid scintillation counting. (auth)

8418 DEEP-WELL DISPOSAL CONTINUES. Greek, B. (Chemical and Engineering News, Houston, TX). Environ. Sci. Technol.; 7: No. 13, 1106-1108(Dec 1973).

Disposal of nonradioactive and radioactive wastes in deep injection wells is briefly reviewed. The importance of creating a national policy on underground waste management is pointed out. (TFD)

Handling Equipment and Procedures

8419 (ORNL-TM-264) CRITICAL MASS STUDIES. Part XII. Rover Reactor Fuel Elements. Johnson, E. B.; Fox, J. K. (Oak Ridge National Lab., Tenn. (USA)). 18 Sep 1962. 25p. Dep. NTIS $3.25.

Declassified 29 Aug 1973.

Critical experiments were performed with fuel elements for the Project Rover KIWI-B-2A reactor to determine nuclearly safe conditions for their production, storage, and transportation. Each element is a 0.746-in.-dia and 50.5-in.-long uranium carbide-graphite cylinder containing seven uniformly spaced longitudinal holes. The uranium concentration is 400 mg/cm^3, of which 93.15% is ^{235}U, yielding a C : ^{235}U atomic ratio of about 90. Throughout the experiments each element was encased in a sealed aluminum tube. In order to establish both the minimum critical number of water-moderated and -reflected elements and the relationship between moderation and critical number, several critical arrays covering a wide range of moderation were assembled. It was found that the minimum critical number of 66 elements, containing about 5 kg of ^{235}U, occurred at an H: ^{235}U atomic ratio of 380. The critical number of unmoderated elements in a reflected array was greater than 2500. Experiments were also performed with uranium oxide-graphite elements from an early stage of production. The minimum critical number of full-length elements in a moderated and reflected array was 40, containing about 4.6 kg of ^{235}U. The H: ^{235}U atomic ratio was 270. Several additional experiments established that the designs of the shipping containers and graphitizing fixture used for the elements are conservative. (auth)

8420 CRITICALITY SAFETY IN PROCESSING AND HANDLING FISSILE MATERIALS. Criticality Data for ^{235}U Metal–Light Water. Draft. Cologne; Beuth (1973). vp. (In German).

Terminology and graphs of critical masses, critical spherical volumes, critical diameters of infinitely extended cylinders and critical layer heights of infinitely extended base areas of maximum reflected homogeneous ^{235}U metal–water mixtures are given. ^{235}U concentration as a function of the moderator-fissile material ratio at a ^{235}U density of 18.9 g/cm^3 is given. (GE)

8421 TANKS FOR LIQUIDS CONTAINING FISSIONABLE MATERIAL. Clelland, D. W. (to United Kingdom Atomic Energy Authority). US Patent 3,768,782. 30 Oct 1973. Priority date 23 Sep 1970, United Kingdom of Great Britain and Northern Ireland. 2p.

A high capacity tank for handling liquids containing fissionable material and having recirculating and mixing means which prevent the creation of critical masses is described. (2 Claims, 1 Drawing Figure) (Official Gazette)

8422 APPARATUS AND METHOD FOR LOADING NUCLEAR FUEL INTO A SHIPPING CASK WITHOUT IMMERSION IN A POOL. Jones, C. R. (to Transfer Systems Inc.). US Patent 3,765,549. 16 Oct 1973. Filed date 21 Oct 1971. 8p.

Apparatus and a method for loading nuclear fuel into a dry shipping cask are described. It is characterized by introduction of the transport vehicle carrying the shipping cask into the reactor building below an auxiliary pool connected to the fuel storage pool. The cask is elevated to an upright position and its open end sealed to the auxiliary pool walls to constitute in effect the pool bottom. Novel cask elevating and cask and vehicle locking means are described. A novel double seal providing leakage detection is also described. (15 Claims, 2 Drawing Figures) (Official Gazette)

8423 CRITICALITY OF TRANSURANIUM ELEMENTS. Clayton, E. D. (Battelle-Northwest, Richland, Washington). Nippon Genshiryoku Gakkaishi; 14: No. 12, 699-701(Dec. 1972). (In Japanese).

Criticality of transuranium elements is described from the viewpoint of safety management. The neutron multiplication factor (k_∞) is 2.7 for metallic Pu, and 1.8 for a wide range of commonly used ^{239}Pu-water mixtures. Critical mass and critical radius were investigated for the spherical system of the Pu-water mixtures. The study was started from α-phase metal. The critical mass and critical radius increased by dilution with water. Maximum of the critical mass was seen at 5 kg/l of Pu concentration, and then decreased and reached to a minimum point. The minimum critical mass is $^1/_{10}$ of that of the metallic Pu. The critical radius and critical mass of the even-N transuranium isotopes such as ^{237}Np, ^{238}Pu, ^{240}Pu, ^{241}Am, ^{244}Cm are shown. Rapid decrease of k_∞ with dilution is observed. Therefore, these systems cannot be critical except in fast neutron systems, and the material can be called fissionable. The critical mass of some odd-N elements called fissile transplutonium nuclides was investigated. Very small values were obtained by calculation. The minimum critical mass of ^{251}Cf is 10 g, and the concentration for this value is 6 g/l. This study suggests the possibility of discovering some transplutonium element with a critical mass of 1 g or less. (JA)

8424 MACHINE TOOL FOR MULTIPLE OPERATIONS, PREFERABLY FOR NUCLEAR APPLICATIONS. Gillot, R.; Montellanico, P.; Righino, E.; Sgarlata, A. (to EURATOM). Luxemburgian Patent 63,640. 29 Jul 1971. (In French).

Available from the Commission of European Communities, Luxembourg.

A remotely controlled machine is described for multiple operations such as opening, unscrewing, welding and screwing of radioactive materials and articles comprising a circular plate on which are disposed a rotating plate with movable jaws, a turret with a tool carriage for said operations and a column with a vertically movable slide; disposed beneath the circular plate are the motor and reduction gear unit for the rotating plate, the mechanical transmission for the forward and reverse movement of the tool carrier, for the slide and the connections for the vacuum pump and for gases. A glass bell caps the circular plate. (auth)

Transportation

8425 (DP-MS-73-65) SAFETY PHILOSOPHY IN THE TRANSPORTATION OF RADIOACTIVE MATERIAL. Langhaar, J. W. (Du Pont de Nemours (E. I.) and Co., Wilmington, Del. (USA). Atomic Energy Div.). [nd]. 8p. (CONF-731105-9). Dep. NTIS $3.00.

From Winter meeting of American Society of Mechanical Engineers; Detroit, Michigan, USA (11 Nov 1973).

The "radiological" and "common cause risks" involved in transporting radioactive materials are briefly discussed. (TFD)

8426 (HEDL-SA-628) PACKAGING FOR FFTF DRIVER FUEL PINS AND ASSEMBLIES. Edgar, J. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1973. 22p. (CONF-731101-41). Dep. NTIS $3.25.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The Model 60 and the F-144-1 packages for shipping FFTF fuel have been developed and are now available for use. The design, testing, and safety analysis of these packages as well as the road testing program to determine handling procedures for these containers in controlled and uncontrolled transportation environments are described. (TFD)

8427 (LCA-NT-217-E-T) MONTE CARLO METHOD FOR STUDYING THE RADIOPROTECTION OF A RADIOACTIVE PRODUCT CONTAINER (EXAMPLE OF RADIOPROTECTION CALCULATIONS). Demonsant, J. (Laboratoire Central de l'Armement, 94 - Arcueil (France). Dept. Detection Protection Nucleaire). 5 Oct 1972. 35p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

A Monte Carlo method is presented for calculating the thickness of the walls of a radioactive product container in view of reducing the outside dose rate to values consistent with current legislation. A cylindrical lead or uranium container is considered the cylindrical cavity of which is designed to contain sand coated with ^{140}La. (FR)

8428 (UNI-SA-3) CRITICALITY SAFETY EVALUATION OF WOODEN PALLETS FOR TRANSPORTING N-REACTOR FUEL. Toffer, H.; McNeece, J. P.; Fowler, K. L. (United Nuclear Industries, Inc., Richland, Wash. (USA)). Jul 1973. Contract AT(45-1)-1857. 16p. (CONF-731101-24).

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The fuel assemblies are transported by truck in the shipping and storage pallet. A maximum of 36 uranium metal fuel assemblies with an enrichment of either 0.95 or 1.25 wt % ^{235}U can be loaded in one pallet. The pallet's design fixes the fuel elements at a lattice pitch of 4.75 in., a distance, which upon flooding, would

guarantee sub-criticality for the fuel. Criticality studies of the fuel-containing pallets under normal and accident conditions were analyzed with both the KENO Monte Carlo code and HAMMER calculations. Under normal transport conditions and for accidents involving rearrangement of pallets and moderator addition, the fuel shipments are safe, $k_{eff} < 90$. (TFD)

8429 (Y-DR-51) CRITICALITY ANALYSIS OF BULK URANIUM OXIDE SHIPPING CONTAINER. Thomas, J. T. (Oak Ridge National Lab., Tenn. (USA)). [nd]. Contract W-7405-eng-26. 14p. Dep. NTIS $3.00.

A study was performed to determine the nuclear criticality safety of a proposed 55-gal-drum shipping container to be utilized for bulk shipments of low ^{235}U content uranium oxides. The container is composed of two 5-gal pails in a 30-gal drum which, in turn, is centered in the 55-gal drum. The insulating material is a mixture of vermiculite and binders. The resultant package was determined to meet the regulatory requirements for a Class I shipping container. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 8903 and 8993.

8430 (LBL-1992) SUPERHILAC AND THE BERKELEY SUPERHEAVY ELEMENT PROGRAM. Ghioroso, A. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. 13p. (CONF-730927-3). Dep. NTIS $3.00.

From 24th congress of the International Union of Pure and Applied Chemistry; Hamburg, F.R. Germany (3 Sep 1973).

A nontechnical description of the SuperHILAC, now under construction, is presented. The injector, linear accelerators, and mass separator for identifying heavy elements are described, along with the basic layouts of the injector and target areas. (7 figures) (RWR)

8431 ACCELERATOR HEALTH PHYSICS. Patterson, H. W.; Thomas, R. H. New York; Academic Press, Inc. (1973). 677p. $18.50.

Topics by chapter title include: fundamental particles and their interactions with matter; radiation fields: their specification and measurement; particle accelerators and their radiation environments; human response to ionizing radiation; the measurement of radiation fields—radiation detectors; accelerator shielding; induced activity at accelerators; and administration of an accelerator health physics program. Also, an appendix is presented in the form of a laboratory manual that includes 12 laboratory experiments and radiation surveys. The text includes a comprehensive bibliography. (WHK)

8432 DEVELOPMENT OF AN INTENSE PULSED RELATIVISTIC ELECTRON BEAM OF LARGE DIAMETER AND UNIFORM FLUX. Thornton, E.; Harris, R. R. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). J. Phys., E (London); 6: No. 12, 1223-1232(Dec 1973).

Experiments were carried out on a 4 MeV pulsed electron-beam generator of $\nu/\gamma \simeq 1$, in order to obtain a broad, uniform flux distribution for sample irradiations. Various cathodes were tested, and a design using multiple razor-blade emitters was chosen for its uniform emission and small electron angles. The flux of the propagated beam was measured as a function of both radial and axial distance in the irradiation drift tube. Small electron angles and the relatively uniform flux distribution of the injected beam resulted in propagation with a slow change of radial flux profile as a function of axial drift distance. Between the positions of maximum convergence the irradiation flux passed through regions with a fairly uniform flux of 40 cal cm^{-2} over a diameter of 100 mm. The axial positions of convergence of the beam were in agreement with simple models of propagation, and the measured depth-deposition profiles in graphite were in agreement with Monte Carlo predictions. (auth)

Auxiliaries and Components

8433 (BNL-18240) STANDARD PRESENTATION OF MAGNETIC MEASUREMENTS ON CIRCULAR OR SQUARE APERTURE DIPOLES. Dahl, P. F.; Danby, G. T.; Hahn, H.; Hsieh, S. Y.; Jackson, J.; Morgan, G. H.; Parzen, G.; Sampson, W. B. (Brookhaven National Lab., Upton, N.Y. (USA)). 17 Sep 1973. 10p. Dep. NTIS $3.00.

Definitions of magnet properties obtained from magnetic measurements are given and methods of presenting these properties are standardized. (auth)

8434 (JINR-P9-7407) DATA GATHERING SYSTEM ON THE BASIS OF MINICOMPUTER IN INVESTIGATION OF PARAMETERS USING A PROTON SYNCHROTRON. Kazanskii, G. S.; Kolpakov, I. F.; Nikityuk, N. M.; Susova, G. M.; Khoshenko, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The problems of analysis of the parametric field of a proton synchrotron are described as well as the peculiarities of charged particle accelerators when organizing optimal control systems. A description is given of the initial stage of data gathering on the basis of a mini computer, data processing using the CAMAC devices, and software. (auth)

8435 (RL-73-108) SUPERCONDUCTING DIPOLES FOR BEAM TRANSPORT. Notes Prepared for the GESSS Study Week at Karlsruhe on 1st October 1973. Wilson, M. N. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Sep 1973. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

A recent survey showed that a considerable number of experimentalists plan to use superconducting beam transport magnets at CERN II. It is proposed to satisfy the demand with a small range of "standard" magnets which could be produced in batches of about 10. The design of the dipoles is examined under the following headings: magnet parameters (GESSS specification, desirable features); proposed design of dc dipole magnet (coil cross section, coil ends and winding technique, conductor, assembly and impregnation, thermal contractions, force support, field shapes, critical fields, cryostat, costs). (UK)

8436 ABSOLUTE CALIBRATION OF ELECTROSTATIC ACCELERATORS IN THE ENERGY REGION FROM 0.7 MeV TO 2.1 MeV. Kump, P.; Ramsak, V.; Rupnik, P.; Vakselj, M. (Univ. of Ljubljana, Yugoslavia). Nucl. Instrum. Methods; 112: No. 3, 489-494(1973).

The resonances of the reaction $^{27}Al(p, \gamma)^{28}Si$ in the energy range $E_p = 0.7$ to 2.1 MeV have been used to determine the calibration constant of a magnetic proton beam-energy analyzer very precisely. As well-defined calibration points the midpoints in the rise of thick-target resonance-yield curves were used. The calibration constant has been determined differentially, measuring the proton-energy differences between the resonances via de-excitation γ-rays using a Ge(Li) detector. After the calibration constant was precisely determined, the absolute calibration energies of the resonances were obtained. The well-known 992 keV $^{27}Al(p, \gamma)^{28}Si$ resonance was determined to be 991.97 ± 0.07 keV. The accuracy of the calibration energies obtained competes with the accuracy achieved using the absolute rf-cavity velocity gauge. (auth)

8437 NEW 5 MHz PULSER FOR THE KARLSRUHE 3 MV VAN DE GRAAFF ACCELERATOR. Liese, S.; Roller, D. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). Nucl. Instrum. Methods; 112: No. 3, 551-553(1973).

A 5 MHz pulser for the terminal of a 3 MV Van-de-Graaff is described which produces 10 ns proton pulses with variable repetition rates. (auth)

8438 MULTIWIRE PROPORTIONAL CHAMBER SYSTEM FOR MONITORING THE POSITION AND PROFILE OF A CHARGED PARTICLE BEAM. Hargrove, C. K. (National Research Council of Canada, Ottawa); Legault, J. P.; Bird, L.; Mes, H.; Sancton, R.; Thompson, A. C.; Walters, J. Nucl. Instrum. Methods; 113: No. 1, 141-145(1973).

A multiwire proportional chamber system with a simple capacitive readout has been built to monitor the beam profile and position of charged particle beams. The system was successfully used in a 1 cm diameter proton beam of intensity 10^5 to 10^{11} protons/s. Using a collimated ^{90}Sr source is was found that the position of a beam could be determined to better than 1.5 mm. (auth)

8439 COMPUTER SYSTEM FOR REALTIME CONTROL AND DATA PROCESSING AT A CYCLOTRON LABORATORY. Mertens, B.; Kaltenbach, V. (Institut fuer Kernphysik, Jülich, Ger.). Nucl. Instrum. Methods; 113: No. 1, 125-130(1973).

The computer system described here is associated with three different tasks: cyclotron control, data acquisition and data evaluation. Hard- and software facilities are discussed. The software for realtime control applications was based on a concept which provides high flexibility and easy adaption to changing requirements. (auth)

8440 CONTROL SYSTEM FOR ELECTRON ACCELERATOR. Kawai, T.; Mizusawa, K. I. (to Nisshin Electric Co. Ltd.). Japanese Patent 1973-277. 1 Apr 1969. 2p. (In Japanese).

In an accelerator, an annular detecting coil is placed around the outer surface of a high-voltage cable through which an electron accelerator tube is connected to a dc high-voltage source. The intensity of the electron beam is measured by detecting the electrical current flowing through the high-voltage cable by means of the detecting coil. The signals are fed to a comparator. Output signals are generated from the comparator when the deviation from the preset standard value is detected and fed back to the device for heating the electron gun, thereby regulating the heating current flowing through the electron gun. The electron beam is controlled by the present control system. (JA)

8441 CONTROL SYSTEM FOR ELECTRON ACCELERATOR. Mizusawa, K. I. (to Nisshin Electric Co. Ltd.). Japanese Patent 1973-276. 1 Apr 1969. 2p. (In Japanese).

A control method for the stable and equal operation of several electron accelerators connected in parallel to a single high-voltage

source is described. The filament circuit of the electron-gun power supply of each electron accelerator has a filament current detecting resistance connected thereto. Each electron accelerator has feedback paths connected thereto, which extend from the detecting resistance to the electron-gun power source of the particular electron accelerator and to those of the other electron accelerators. A detecting signal of the resistance is negatively fed back to the particular electron-gun power source by a feedback quantity of $-\beta$. Simultaneously therewith, the signal is positively fed back to each of the electron-gun power supplies of the other electron accelerators. An appropriate selection of the value β holds the electron currents uniform. (JA)

8442 ELECTRONIC CONTROL SYSTEM FOR LINEAR WAVE GUIDE ACCELERATORS. Salome, J. M. (to EURATOM). Luxemburgian Patent 64,858. 29 Feb 1972. (In German).

Available from the Commission of European Communities, Luxembourg.

A diode PIN modulator is interconnected between the UHF-wave-generating oscillator and the amplification stage, and interrupts the passage way of the wave during the rise and the decline of the high tension of the amplification tube. (EU)

Ion Sources and Injection and Extraction Systems

Refer also to abstract 8631.

8443 (RL-73-112) LOW EMITTANCE LOW HALO EXTRACTED PROTON BEAM FOR NIMROD. Atchison, F.; Butterworth, J. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

A low emittance, low halo extracted proton beam for NIMROD has been designed to satisfy the requirements of part of a recent proposal to study spin-dependent effects in proton-proton scattering at 8 GeV/c. The report is divided into the following sections: beam extraction; design considerations (general, halo, interaction, coulomb scattering, ionization loss, collimation for emittance definition, halo scrapers); constraints; the beam (final design—list of components—quadrupoles, bending magnets, collimators). (UK)

8444 STABILIZING SYSTEM OF ACCELERATED CHARGED PARTICLES. Ota, S.; Nakamura, O.; Anazawa, N. (to Japan Electron Optics Lab. Co. Ltd.). Japanese Patent 1973-279. 26 May 1969. 4p. (In Japanese).

A method of unifying the energy of a charged particle beam was devised without an appreciable loss of the beam intensity. Different energy components of the beam are deflected by means of a deflecting magnet into different positions on an appropriate device which gives energy gain and/or loss. The requirement for the device is such that it gives the position-depending energy loss or gain resulting in wearing the energy dispersion of the incident beam off. A wedge-shaped absorber or a cavity resonator applying the electric- or magnetic-field mode is used as such means. For example, a single cavity-resonator of the TM_{021} mode is capable of reducing the energy dispersion of 10% in a beam with the rectangular distribution in energy from the linear accelerator to 0.1% without a loss of the beam intensity which the conventional method results in the 99% loss in the intensity for the same beam quality. (JA)

Ion Optics and Field Calculations

8445 (JINR-P13-7297) HIGH GRADIENT SUPERCONDUCTING QUADRUPOLE MAGNETIC LENS WITH 30 MM APERTURE. Geraskin, E. V.; Grebinnik, V. G.; Zhukov, V. A.; Malyaev, V. Kh.; Manych, A. P.; Selivanov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The preliminary results of the investigation of the experimental model of a superconducting quadrupole magnetic lens with cylindrical poles, designed for focusing hyperon beams, are reported. The aperture of the lens is 3 cm and the field is 16 kG. The measurement of the magnetic field in the aperture of the lens was done by means of a precision mechanism according to the change of the magnetoresistance of a Bi filament. It was found that at $r \leq 1.2$ cm gap of the lens from the axis the maximum size of the gradient of the magnetic field is 12 kG/cm with nonlinearity below 1%. The effective length of the lens was calculated according to the measured form of the curved decrease of the field in the curved region. (tr-auth)

8446 MEASUREMENT OF THE FIELD OF A MAGNETIC QUADRUPOLE LENS BY MEANS OF A HALL PROBE. Hazewindus, N.; Martis, F. (Philips Research Labs., Eindhoven, Netherlands). Nucl. Instrum. Methods; 112: No. 3, 611-613 (1973).

The determination of the harmonic content of the field of a quadrupole lens by means of a simple measurement along a circular path around the optical axis is discussed. Results obtained in this way for normal excitation of the lens and for asymmetrical excitation are presented. (auth)

8447 EMISSION FROM A CHARGED-PARTICLE BUNCH MAKING MULTIPLE PASSES THROUGH A CYLINDRICAL CAVITY. Didenko, A. N.; Kartin, V. I.; Fomenko, G. P. Sov. Phys.-Tech. Phys. (Engl. Trnsl.); 17: No. 11, 1867-1870(May 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 11, 2403-2408(Nov 1972).

The radiated energy from a bunch of high-energy particles ($\gamma \gg 1$) is calculated as a function of the cavity parameters and bunch length. It is found that this energy depends on the number of passes of the bunch through the cavity and on effects due to higher cavity modes. (auth)

8448 NEW METHOD FOR DESIGN OF AXIALLY SYMMETRIC ELECTRON MIRRORS. Kel'man, V. M.; Sekunova, L. M.; Yakushev, E. M. (Inst. of Nuclear Physics, Alma-Ata, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 11, 1786-1791(May 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 11, 2279-2287(Nov 1972).

A method which allows determinations of the paraxial properties of electrostatic axially symmetric mirrors and calculation of the aberration of these mirrors is given. The equations do not contain the time as a parameter. The field distribution functions in the principal optical axis of the mirror appear in the equations. An electrostatic mirror is characterized by five third-order geometric aberrations, for which the aberration coefficients have been determined. The five coefficients can be expressed by four quantities which depend only upon the field distribution. (auth)

8449 ADIABATIC PROCESSES IN A HELICAL MAGNETIC FIELD. Bonch-Osmolovskii, A. G. (Joint Nuclear Research Inst., Dubna, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 11, 1782-1785(May 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 11, 2272-2278(Nov 1972).

A self-consistent field is used in the linear approximation to consider the motion of charged particles in an adiabatic time-varying, weak focusing, azimuthal magnetic field. There is an equilibrium particle configuration in the form of a charged ring, and the adiabatic variation of the minor dimensions of this ring is determined. In particular, if the azimuthal field is strong, the transverse dimensions of the ring vary as $1/\sqrt{H_\varphi}$. (auth)

8450 PARAMETRIC INSTABILITY OF AN ELECTRON BEAM MODULATED BY AN EXTERNAL ELECTROSTATIC FIELD. Aseev, G. G.; Kuznetsova, G. G.; Repalov, N. S.; Khizhnyak, N. A. (Physical-Technical Inst., Kharkov). Sov. Phys. Tech. Phys. (Engl. Transl.); 17: No. 11, 1777-1781(May 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 11, 2264-2271(Nov 1972).

The stability of an electron beam moving through a spatially periodic electric field is analyzed. The conditions for instability are examined, and the growth rate is determined as a function of the electric field. The energy distribution is studied for various modes of operation. Nonlinear saturation of the instability is examined. The results agree with the theoretical model for a parametric instability. (auth)

Storage Rings

Refer also to abstract 7816.

8451 (BNL-18313) BUNCHED BEAM INTERSECTING STORAGE ACCELERATORS FOR PROTON-PROTON COLLISIONS. Month, M. (Brookhaven National Lab., Upton, N.Y. (USA)). 24 Oct 1973. 37p. Dep. NTIS $4.00.

A pair of intersecting storage accelerators is proposed. Using bunched beams colliding heat-on, a luminosity of 10^{32} cm^{-2} sec^{-1} per collision region can be obtained with an average current of 0.7 A (corresponding to ~10 A peak current). The mechanism for obtaining collisions is simply to transfer the bunched AGS beam to the matched ISA rings, accelerate the beams in the ISA rings

to their final energy and collide them. The requirements on the AGS beam are: transverse emittance, $\epsilon \simeq 2.5 \times 10^{-6}$ rad-m at an energy of 30 GeV (note that phase space area = $\pi\epsilon$); longitudinal emittance, A ≃ 1.0 eV-sec/bunch; and intensity ≃ 10^{13} protons per pulse. These are values that are well within the range of the existing AGS. If the ISA is chosen to have a circumference three times that of the AGS, then with a filling factor of 48% (i.e. in order to accommodate injection, fast protective extraction into dumps, rf requirements, vacuum equipment and experimental areas), an energy of 200 GeV can be achieved with 35 kG magnetic fields. This means superconducting magnets. If another AGS circumference is added (i.e. 800 m with a 67% filling factor), an energy of 165 GeV can be obtained with a field of 20 kG. That is, if $R_{ISA} = 4R_{AGS}$, then with normal 20 kG magnets, a top energy of 165 GeV can be reached. A total magnet aperture of 5 cm seems reasonable, although a magnet gap of about 4 cm in the case of normal magnets, where only the vertical dimension is relevant, is acceptable. The rf system, which would be used for matching, acceleration, and storage, would have a frequency of 13 MHz and operate at a voltage of 50 kV/turn peak. Acceleration could be accomplished in less than 1 minute, and rf power consumption would be less than 1 MW. To obtain sufficient beam lifetime and sufficiently low background for experiments, an average pressure at least as low as 10^{-9} torr is recommended. It should be kept in mind that with the simplicity of beam transfer and stacking, and with the speed of the acceleration process, dumping and refilling should not be a major operation and could be performed in about 1 min. It is thus conceivable that the device could be operated in 1 hour cycles. The interaction of the beam with itself, with the other beam and with the surrounding environment is considered. Discussed at various places are: (1) Incoherent space charge tune shifts; (2) Bunched beam transverse resistive wall effect; (3) Head-tail effect; (4) The interaction of the bunched beam with the rf cavity; (5) Proton interaction with electrons produced by ionization of the residual gas; (6) Diffusion from intrabeam scattering; (7) Beam gas interaction; and (8) Beam-beam interaction. Design parameters are chosen so as to negate any potential beam blowup from these phenomena. (auth)

Experimental Facilities

8452 (RL-73-116) COMPUTING AND AUTOMATION DIVISION QUARTERLY REPORT 30 JUNE 1973–30 SEPTEMBER 1973. Walkinshaw, W.; Lea, A. T. (eds.). (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

The quarterly report, for 30 June to 30 September 1973, of the computing and automation division of the Rutherford Laboratory is presented under the following principal headings: operations (general, reliability and availability, hardware, system software); workload; remote and terminal facilities (workstations, workstation installation, documents and accounts, ELECTRIC); computer system development; user support (general, ELECTRIC usage, disk usage, packages); film measuring (HPD 1, CYCLOPS, IDI display and light pen, HPD 2). (UK)

8453 TARGET FOR NEUTRON PRODUCTION IN ACCELERATOR INSTALLATIONS. Fabian, H. (to Nukem GmbH). US Patent 3,766,390. 16 Oct 1973. Priority date 27 Aug 1970, F. R. Germany. 2p.

A target for neutron production is developed that is provided laterally of the target with a hydride accumulator from which the tritium is fed by heating of the target material. (7 Claims, 1 Drawing Figure) (Official Gazette)

8454 TARGET FOR PRODUCING NEUTRONS. Fabian, H. (to Nukem Nuklear-Chemie und -Metallurgie GmbH). US Patent 3,766,389. 16 Oct 1973. Priority date 2 Feb 1970, F. R. Germany. 2p.

A target for producing neutrons is composed of layers of hydrides mounted on a plate impermeable to hydrogen. This increases the life of the target. (5 Claims, 1 Drawing Figure) (Official Gazette)

8455 SENSITIVITIES OF SHORT LIVED ISOMERS. Sato, Y.; Miki, R.; Kondo, Y.; Azuma, T. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 52-54(1972).

The sensitivities of short-lived isomers in second order produced by electron linac of 16 MeV, 30 μA, 30 sec irradiation, and by VdG of 0.4 MeV, 20 μA, 60 sec irradiation, were observed by using a Ge(Li) detector. The performance of a pneumatic transfer system of dual type is reported. (auth)

8456 IMPROVED TECHNIQUE FOR THE PREPARATION OF THIN DEUTERATED-POLYETHYLENE TARGETS. Bartle, C. M.; Meyer, H. O. (Univ. of Wisconsin, Madison). Nucl. Instrum. Methods; 112: No. 3, 615(1973).

Self-supporting uniform deuterated-polyethylene foils with thicknesses between 10 μg/cm² and 2.5 mg/cm² and with an area of about 5 cm² have been prepared. Control of the temperature conditions, substrate and the solvent-evaporation rate determine the quality of the foils. (auth)

8457 PREPARATION OF MERCURY TARGETS. Fehr, E. B.; Peschel, R. E. (Yale Univ., New Haven). Nucl. Instrum. Methods; 112: No. 3, 617-618(1973).

Stable accelerator targets of mercury were prepared by coating gold amalgam foils with a thin bismuth layer. (auth)

8458 APPLICATION OF A SYNCHROCYCLOTRON TO NEUTRON CAPTURE ELEMENTAL ANALYSIS. Jarvis, O. N.; Sherwood, A. C.; West, D.; Whitehead, C. (Atomic Energy Research Establishment, Harwell, Eng.). Nucl. Instrum. Methods; 112: No. 3, 559-565(1973).

The Harwell synchrocyclotron has been investigated as a tool for the production of a localized neutron flux whose applicability to the field of elemental analysis via the study of prompt and delayed gamma-ray emission following neutron capture has been demonstrated using large (≈100 g) samples. (auth)

8459 HELIUM-JET TRANSPORTATION OF RECOIL ATOMS INTO A LIQUID PHASE. Puumlainen, P.; Aeystoe, J.; Valli, K. (Univ. of Jyvaeskylae, Finland). Nucl. Instrum. Methods; 112: No. 3, 485-487(1973).

A rapid inexpensive method has been developed for transportation of recoiling short-lived radioactive nuclides from a target chamber over distances of several meters into a liquid phase. This allows rapid radiochemical separation of different elements. The carrier-loaded helium-jet transport technique is employed without a pumping system. The method would appear to be applicable to most chemical elements. The transport efficiency is higher than 50% and the transport time can be made much shorter than 1 s. Radiochemical separation times of a few seconds were achieved. (auth)

8460 ELECTRON BEAM WITH MOMENTA UP TO 46 GeV/c AT THE SERPUKHOV ACCELERATOR. Gershtein, S. S. (Inst. for High Energy Physics, Serpukhov, USSR); Samoylov, A. V.; Sapunov, Yu. M.; Frolov, A. M.; Alikhanyan, A. I.; Bayatyan, G. L., Vartanyan, G. S. Nucl. Instrum. Methods; 112: No. 3, 477-483(1973).

An electron beam with maximum momentum p ~ 46 GeV/c has been developed at the Serpukhov proton synchrotron. The beam intensity varies from 10^6 electrons at 26 GeV/c to 3×10^4 electrons at 46 GeV/c for 10^{12} protons circulating in the accelerator at 70 GeV; these intensities are for a ±3% momentum bite and spill lengths of up to 2 s. Electrons with momenta p< 26 GeV/c are produced by decrease of proton energy. Hadron and muon impurity in the beam is less than 1% at momenta p ~ 26 to 40 GeV/c and increases to 3.6% at p = 45.5 GeV/c. A beam of tagged photons with energies between 12 and 40 GeV has also been developed. (auth)

8461 SHIELDING CAVE FOR LOW-LEVEL γ EXPERIMENTS ON VAN de GRAAFF ACCELERATORS. Neal, G.; Humphrey, C.; Ritter, R.; Schier, W. A. (Univ. of Virginia, Charlottesville). Nucl. Instrum. Methods; 113: No. 1, 119-123 (1973).

A pill-box shaped γ cave of 1.25 × 1.25 m² interior dimensions was constructed of interlocking sections. Carefully fitted walls having a thickness of 14 cm lead and 1.3 cm steel provide shielding against background radiation from a 5.5 MV Van de Graaff Accelerator (type CN, High Voltage Engineering). Protection against accelerator bremsstrahlung radiation, control slit activity and miscellaneous beam-induced external activity is such that cosmic radiation and other natural background is the normal limiting factor in experiments. Thus far experiments measuring de-excitation γ-rays and target x-rays with NaI, Ge(Li) and Si(Li) detectors have been accomplished with low background. (auth)

8462 CHARGED PARTICLE MASS IDENTIFICATION BY ENERGY-TIME-OF-FLIGHT TECHNIQUE. Andrade, E.; Rendic, D.; Otte, V. A.; Phillips, G. C. (Rice Univ., Houston, TX). Nucl. Instrum. Methods; 113: No. 1, 93-99(1973).

The energy-time-of-flight technique for charged particle mass identification has been successfully used in the mass range from mass 1 to 12 and in the energy range from 0.5 MeV to 11 MeV. As an illustration of the usefulness of the technique, the results of the analysis of the reactions produced by ^{12}C nuclei bombarded by deuterons at 12 MeV are presented. The pulsed and bunched beam facilities of the Rice University tandem Van de Graaff were used, and particles resulting from the bombardment were

detected with a silicon surface barrier solid state detector. The energy and time-of-flight parameters were processed using an IBM 1800 real time computer with an ADC resolution of 1024 channels for each parameter. Twenty-six energy peaks from the $^{12}C(d,y)Y$ reaction were identified, while, for comparison, the free energy spectrum provides only ten peaks. (auth)

8463 LARGE GENERAL PURPOSE SCATTERING CHAMBER. Gunn, G. D.; Schmick, T. A.; Wright, L.; Fox, J. D. (Florida State Univ., Tallahassee). Nucl. Instrum. Methods; 113: No. 1, 1-3(1973).

An inexpensive charged-particle scattering chamber has been constructed from a large obsolete dry ice trap. A removable platform mounted on a linear bearing contributes to the chamber's versatility and convenience. The chamber's construction permits cooling of solid state detectors to improve resolution and to make possible the utilization of marginal detectors. Electrical motors are used to change beam defining apertures, targets and detector angles. No movable vacuum seals are used in this design. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Cosmic Radiation

Refer also to abstract 8520.

8464 (AECL-4599) COSMIC RAY NM-64 NEUTRON MONITOR DATA FROM KULA, HAWAII AND MONTHLY GRAPHS, January–December 1972. Steljes, J. F. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1973. 43p. Dep. NTIS (U. S. Sales Only) $4.25. AECL $1.50.

Uncorrected and barometer-corrected hourly data from a 3-NM-64 mobile latitude survey neutron monitor stationed at Kula, Maui, Hawaii, are given in tabular form for the period from January 1972 to December 1972. Graphs of the corrected data are given. (auth)

8465 (JINR-P7-7406) IDENTIFICATION OF THE TRACKS OF HEAVY NUCLEI OF THE PRIMARY COSMIC RADIATION IN MINERALS FROM METEORITES. Otgonsuren, O.; Perelygin, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The problem is considered of the detection and identification of extended tracks of superheavy cosmic nuclei in the olivine crystals from meteorites. The sensitivity of olivines to the heavy charged particles is studied. The effect of regression of latent tracks in space conditions was observed for olivines from the meteorities Lipovsky, Khutor, and Marialahti. The value is obtained for the upper limit of intensity of cosmic nuclei in the region $Z \geq 70$ at the level 3 to 5.10^{-7} with respect to Fe group nuclei for these crystals. (auth)

8466 (LBL-2180) LOCATING CHAMBERS IN AN EGYPTIAN PYRAMID USING COSMIC RAY MUONS. Lynch, G. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1973. Contract W-7405-eng-48. 11p. (CONF-730541-4). Dep. NTIS $3.00.

From symposium on advanced technology arising from particle physics research; Argonne, Illinois, USA (17 May 1973).

A brief report is given on the attempt to detect a chamber or chambers in the Second Pyramid of Chephen at Giza by using cosmic-ray muons. (WDM)

8467 (LNF-73/37) MULTIPLICITY DISTRIBUTION OF SHOWER PARTICLES UNDERGROUND AND THE COSMIC RAY PRIMARY SPECTRUM. Bergamasco, L.; Castagnoli, C.; D'Ettorre Piazzoli, B.; Picchi, P.; Sitte, K.; Visentin, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 26 Jun 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

Ever since the discovery of "muon bundles," groups of penetrating particles with nearly parallel tracks, it has been hoped that their size and radial distribution would provide evidence on details of the processes of secondary production in high-energy collisions. An attempt is made to show, from an analysis of experimental results recently obtained, that neither the composition of the primary cosmic radiation, nor the characteristics of hadronic interactions, undergo drastic changes in the energy range above some 10^{15} eV. (WDM)

8468 (LUIP-CR-73-1) ANALYSIS OF PHOTOMETRIC MEASUREMENTS OF TRACKS PRODUCED BY HEAVY COSMIC RAY PARTICLES STOPPING IN A STACK OF NUCLEAR EMULSIONS. Behrnetz, S.; Kristiansson, K.; Lindstam, S.; Soederstroem, K. (Lund Univ. (Sweden). Fysiska Institutionen). Jan 1973. 55p. Dep. NTIS (U. S. Sales Only) $4.75.

An investigation of the chemical composition of the cosmic radiation has been made for the elements with $Z \geq 14$. Tracks of heavy primaries were registered in a stack of nuclear emulsions during a balloon flight over northern Canada at 2.7 g/cm^2 of residual atmosphere. The tracks of 253 stopping particles with $Z \geq 14$ were measured with a nuclear track photometer. The photometer data were corrected for different measuring and emulsion effects, and 156 particles were selected for a charge spectrum. The standard deviation of the charge determinations amounts to 0.2 units of charge for silicon and 0.3 units for iron. Relative abundances are given for the elements silicon to nickel. This report is mainly concerned with the experimental details and the reduction of the photometer data. The results will be discussed elsewhere. (SW)

8469 COSMOCHEMICAL VIEW OF COSMIC RAYS AND SOLAR PARTICLES. Price, P. B. (Univ. of California, Berkeley). Space Sci. Rev.; 15: No. 1, 69-88(Sep 1973).

The composition of cosmic rays and solar particles is reviewed with emphasis on the question of whether they are representative samples of galactic and solar matter. The composition of solar particles changes with energy and from flare to flare. A strong excess of heavy elements at energies below a few MeV/N decreases with energy, and at energies above ~15 MeV/N the comparison of solar particles resembles that of galactic cosmic rays somewhat better than that of the solar atmosphere. The elements Ne through Pb have remarkably similar abundances in cosmic-ray sources and in the matter of the solar system. The lighter elements are depleted in cosmic rays, whereas U and Th may be enriched or not, depending on whether the meteoritic or solar abundance of Th is used. Two prototype sources of cosmic rays are considered: gas with solar-system composition but enriched in elements with $Z > 8$ during acceleration and emission (by analogy with solar particle emission), and highly evolved matter enriched in r-process elements such as U, Th, and transuranic elements. The energy-dependence of cosmic-ray composition suggests that both sources may contribute at different energies. (auth)

8470 AUGUST 1972 COSMIC RAY EVENT AS OBSERVED AT DIFFERENT STATIONS BY IDENTICAL IONIZATION CHAMBERS. Chuang, L. S. (Chinese Univ. of Hong Kong, Shatin); Kawasaki, S.; Nakano, Y.; Wada, M.; Miyazaki, Y. Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 67: No. 1, 1-6(Mar 1973).

A world-wide cosmic-ray variation started on August 4, 1972, was detected simultaneously by identical ionization chambers at Sapporo, Mt. Norikura, Tokyo-Itabashi, and Hong Kong, which lie around 135° east longitude band at different altitudes and have vertical cutoff rigidities ranging from 8 to 16 GeV. Together with the hourly intensities obtained by the chambers, the neutron intensities observed at Mt. Norikura and Tokyo are also considered. A comparison of the amounts of variation obtained by different detectors gives information about the variation spectrum of the primary cosmic rays. There were large amplitude oscillations in intensity during the period from 20h on August 4 to 8h on August 5. From an inspection of the time intensity profiles of respective detectors, it is clearly revealed that the spectrum of a narrow, deep minimum at 1h on August 5 is of lower rigidity type than that of the succeeding second minimum. The 1h minimum with peaks on both sides may relate to a passage of the solar wind of extremely high velocity (>1000 km/sec). (auth)

8471 COMMENT ON THE DUST GRAIN MODEL FOR PRIMARY COSMIC RAYS. Terasaki-Okada, K. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2147-2149(Jun 1973).

8472 COMPARISON OF CALCULATIONS OF CHARACTERISTICS OF EXTENSIVE AIR SHOWERS WITH EXPERIMENTAL RESULTS FOR DIFFERENT HEIGHTS. Popova, L. M. Compt. Rend. Acad. Bulg. Sci.; 26: No. 6, 743-746(1973). (In Russian).

Experimental results are compared with published data (10 references), and cases of agreement and disagreement are discussed. (TTT)

8473 POSSIBLE EXISTENCE OF ANOMALOUS INTERACTION OF MUONS AT ENERGIES ABOVE 10 TeV. Kalmykov, N. N.; Khristiansen, G. B. (Moscow State Univ.). Yadern. Fiz.; 18: No. 5, 1070-1074(Nov 1973). (In Russian).

To explain the disagreement between the experimental spectra of energy release from muons, obtained by means of ionization chambers ($\gamma\mu \simeq 2$), and those obtained by means of X-ray films ($\gamma\mu \simeq 2.6$), a hypothesis of anomalous interaction of muons with energies above 10 TeV is considered. Approximate characteristics of this interaction are determined and it is shown that the hypothesis present does not contradict to the observable intensity of horizontal air showers. (auth)

Stars

Refer also to abstract 9056.

8474 NARROW-BAND OI INDEX FOR A- AND F-TYPE STARS. Sorvari, J. M. Rochester, NY; Univ. of Rochester (1973). 151p. Microfilms Order No. 73-25,853.

Thesis (Ph. D.).

A photometric system based on the OI triplet λλ 7771, 7774, 7775 has been developed and calibrated with respect to equivalent width. This system, the r(OI) system, uses a 10A and a 60A filter to measure the strength of the oxygen feature to an accuracy of ±0.004m, equivalent to ±0.06A, for a single observation. The r(OI) system was shown to provide a temperature sensitive parameter for A-type stars and a luminosity sensitive param-

eter for F-type stars. The combination of Hβ and r(OI) photometry is shown to provide a useful, reddening free, two-dimensional classification system. Normal stars are found to populate fairly well defined regions of the r(OI)-spectral type plane, with the remaining gaps being associated with various peculiar and variable stars. By using stars in galactic clusters, a relationship between r(OI) and absolute magnitude has been calibrated for F-type stars. The mean deviation of the seven calibration stars from the linear relationship is 0.2m. The cepheid variables η Aql and δ Cep are shown to obey this relationship at maximum light. (Diss. Abstr. Int., B)

8475 NUCLEO-COSMOCHRONOLOGY. Schramm, D. N. (California Inst. of Tech., Pasadena). Space Sci. Rev.; 15: No. 1, 51-67(Sep 1973).

A review is made of the basis of nucleo-cosmochronologies, emphasizing the model independent approach. The exponential model as well as recent galactic evolution models are discussed. The r-process chronometer pairs $^{232}Th/^{238}U$, $^{235}U/^{238}U$, $^{244}Pu/^{232}Th$, and $^{129}I/^{127}I$ are discussed in detail. The possible development of other chronometer-pairs is also discussed. In particular it is shown that the $^{187}Re-^{187}Os$ system may eventually be able to determine the mean age of the elements to higher precision than any other r-process chronometer because all of the parameters are experimentally measurable. The possibility of a p-process chronology based on ^{146}Sm and an s-process chronology from ^{176}Lu is also examined. (auth)

8476 STELLAR AND SOLAR ABUNDANCES. Pagel, B. E. (Royal Greenwich Observatory, Hailsham, Eng.). Space Sci. Rev.; 15: No. 1, 1-21(Sep 1973).

Recent spectroscopic results on stellar and solar abundances are reviewed with special reference to (a) standard abundance distribution (Sun, hot stars, diffuse nebulae); (b) abundance peculiarities related to stellar evolution (red giants showing results of H-burning and s-process, peculiar and metallic-lined stars); and (c) population effects that may be related to the evolution of the Galaxy (correlation between stellar age and metal abundance, differences in details of heavy-element mixture in atmospheric composition of normal stars that have not reached an advanced evolutionary stage). (auth)

8477 THEORIES OF NUCLEOSYNTHESIS. Truran, J. W. (Yeshiva Univ., New York). Space Sci. Rev.; 15: No. 1, 23-49 (Sep 1973).

A review is presented of current theories of nucleosynthesis. The predicted contributions from (1) cosmological nucleosynthesis, (2) super-massive stars, (3) nonviolent (quasi-static) stellar evolution, (4) supernova explosions, (5) cosmic-ray interactions with the interstellar medium, and (6) nova explosions to the observed solar system abundances are summarized. Recent studies of "explosive nucleosynthesis" in supernovae and of the production of lithium, beryllium, and boron by the interaction of cosmic rays with interstellar gas are emphasized. Observations of stellar spectra which either impose limitations upon or provide confirmation of various aspects of these theories are noted, as are several critical nuclear experiments. The general picture which emerges is encouraging in that most of the major abundance features appear to be at least qualitatively understood, but significant further research is required. (auth)

8478 EFFECT OF ELECTRON CAPTURE ON TEMPERATURE AND CHEMICAL COMPOSITION IN COLLAPSING DENSE STARS. Nakazawa, K. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 6, 1932-1946(Jun 1973).

The effects of electron capture on the changes of temperature and the chemical composition in collapsing dense stars were investigated. The entropy production (or loss) due to electron captures was taken into account. This entropy change comes from two factors: One is the entropy loss due to neutrinos emitted by electron capture processes and the other is the entropy change due to the distortion of Fermi distribution of electrons. Results were obtained by computing numerically under the following assumptions: (1) The density of matter changes with time as if a star contracted without pressure force. (2) Neutrinos emitted by electron capture are assumed to escape freely from a star. Other cooling processes such as energy loss by neutrinos due to $(e\bar{\nu})$ $(\bar{e}\nu)$ interactions and thermal diffusion were neglected. (3) In the higher temperature regions than 3×10^{9}°K, nuclear statistical equilibrium was assumed to be attained instantaneously. (4) Beta processes other than electron capture were neglected because of the high degeneracy. As to the beta transition, a super allowed transition was assumed; i.e., (ft) = 10^{4} sec for all nuclei. It was found that when the degeneracy parameter ψ is greater than 10, the entropy increases in spite of the energy loss through neutrinos emitted by electron capture. The main chemical elements were found to be limited to the following: n, p, ^{4}He, ^{56}Fe, ^{56}Mn, ^{56}Cr, ^{48}Ca, ^{72}Ni, ^{80}Zn, ^{82}Ge, ^{120}Sr, ^{50}Ti, ^{76}Fe, and ^{119}Sr. The last eight elements are neutron rich nuclei with neutron or proton magic numbers. (auth)

8479 THERMONUCLEAR SUPERNOVA IN BINARY HELIUM DWARFS. Mazurek, T. Yeshiva, NY; Yeshiva Univ. (1973). 210p. Microfilms Order No. 73-24,805.

Thesis (Ph. D.).

This thesis investigates the Type I supernova model proposed by Truran and Cameron (1971), which consists of a helium dwarf in a binary pair of low-mass stars (each around one solar mass) that evolves to densities sufficiently high to result in a cataclysmic instability at helium ignition. The investigation ramifies into the three salient questions of (1) the evolution of the helium dwarf during accretion into the unstable configuration, (2) the degree of instability at helium ignition, and (3) the hydrodynamics of a helium thermonuclear supernova. The evolutionary aspects are studied in a preliminary manner in terms of energy growth and loss balancing in dwarfs in hydrostatic equilibrium. The degree of instability upon central thermonuclear runaway is investigated via the Rankine–Hugoniot and Chapman–Jouguet theories of steady state discontinuous wave propagation. The hydrodynamics of the helium supernova are investigated through a numerical computer code which included the following physical processes: (1) The thermodynamic state equations accounted for degenerate electrons, positrons, ions, and photons. (2) The nuclear energy generation was approximated by network of fourteen nuclei. (3) The properties of matter in nuclear equilibrium were approximated by a network of 155 nuclei. (4) The effects of electron capture on the equilibrium nuclei were included; the individual nuclear decay rates have been recomputed on the basis of a new strength function. The conclusions are that a supernova event with complete disruption is the result of a thermonuclear runaway in all helium dwarfs with masses in the range $0.7\ M_{\odot} \lesssim M \lesssim 1.4\ M_{\odot}$, and that the most probable mass of a helium dwarf supernova progenitor would be less than $1\ M_{\odot}$. (Diss. Abstr. Int., B)

8480 COMPARISON OF CORE AND SHELL SPECTRA OF ETA CARINAE AND SCATTERING MECHANISMS IN THE SHELL. Craine, E. R. Columbus, OH; Ohio State Univ. (1973). 138p. Microfilms Order No. 73-26,793.

Thesis (Ph. D.).

Although the nebular object Eta Carinae has long been studied as an interesting object, relatively little attention has been paid the shell regions surrounding the bright core. In this work the spectra of the core and shell regions are compared in both a qualitative and quantitative sense. A spectral atlas has been constructed to facilitate visualization of the striking differences between the two types of spectra. In addition to the atlas, quantitative measurements of relative line intensities and equivalent widths have been recorded. An attempt has been made to evaluate the possibility of scattering mechanisms in the shell region of Eta Carinae by postulating a simple model and evaluating the effects of scattering upon the shell lines. Evidence is presented to support the contention that permitted lines in the shell are scattered from the core. This is the first quantitative study of the shell spectrum of Eta Carinae and it indicates numerous differences between the core and shell regions. It seems likely that the scattering processes in the shell involve grain scattering as well as the previously suggested electron scattering. (Diss. Abstr. Int., B)

8481 COAL SACK. I. The Search for Flare-Star Spectra. II. Photometry of Suspected Flare Stars. III. The Search for T Tauri Stars. Weaver, W. B. Cleveland; Case Western Reserve Univ. (1972). 71p. Microfilms Order No. 73-16,172.

Thesis (Ph. D.).

The Coal Sack was searched with photographic photometric and objective-prism techniques for flare stars and T Tauri stars. No evidence for a significant number of either was found, contrary to the suggestion of preliminary results of other investigators. (Diss. Abstr. Int., B)

8482 FORMATION OF ELEMENTS IN NEUTRON RICH EJECTED MATTER OF SUPERNOVAE. Sato, K.; Nakazawa, K.; Ikeuchi, S. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 4, 1166-1183(Apr 1973).

The thermal and chemical properties of neutron-rich ejected matter of supernovae are investigated from the high-temperature stage ($T \sim 5 \times 10^{10}$ K) to the low-temperature stage ($T \sim 3.2 \times 10^{9}$ K) under an appropriate assumption for the expansion law. Changes of the entropy and of the electron mean molecular weight due to the beta process were taken into account, which are essentially different from previous relevant works. The initial n/p ratio is determined by the chemical equilibrium between neutrons, protons, and leptons when the matter is opaque to electron neutrinos, whereas it is given by a steady state condition in the case that the matter is transparent. Considering reactions by nucleon

weak interaction, nuclear statistical equilibrium and nuclear beta decays, the initial conditions for the r-process such as the abundances of seed nuclei, the neutron flux and the density of the matter are obtained for various expansion speeds and initial n/p ratios. It is shown that the entropy production and the decrease of mean molecular weight of the electron due to the beta process play an important role, and in the cases of slow expansion, neutrons are exhausted due to fast nuclear beta decays before the r-process proceeds, whereas in the cases of fast expansion and/or with the large initial n/p ratios, a sufficient amount of free neutrons are left for r-process. Finally the dynamic r-process is discussed on the basis of the numerical results. (auth)

8483 PHOTOMETRY OF MINIMA OF U CEPHEI. Bakos, G. A.; Tremko, J. (Astronomical Inst., Skalnate Pleso, Czech.). Bull. Astron. Inst. Czech.; 24: No. 5, 298-305(1973).

From photoelectric observations made in 1968 and 1969 the light curve of both minima in the B spectral range was derived. A further lengthening of the period was established. (auth)

8484 PERIOD OF THE ECLIPSING BINARY TV CASSIOPEIAE. Bakos, G. A.; Tremko, J. (Astronomical Inst., Skalnate Pleso, Czech.). Bull. Astron. Inst. Czech.; 24: No. 5, 305-310(1973).

Photoelectric observations of minima of TV Cas are presented and the variations of the period of the system discussed. (auth)

8485 PHOTOELECTRIC PHOTOMETRY AT THE HVAR OBSERVATORY. I. The Eclipsing Binary BR Cyg. Harmanec, P.; Koubsky, P.; Horn, J.; Havelka, J. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 5, 311-320(1973).

A three-color photoelectric photometry in an instrumental system close to the international UBV-system is presented for the eclipsing binary BR Cyg. Some peculiarities of the light curve are briefly discussed. Times of two primary minima were determined. New light elements Hel Min I = J. D. 2441539.4654 + 1.33256415^{d}.E were derived from all the published photoelectric and photographic minima. The new period also agreed well with all the times of the minima published by visual observers, and there is no reason to expect a secular change of the period. More photoelectric minima are needed to decide, if there are some small cyclic variations of the period. (auth)

8486 TEMPERATURE-DEPENDENT SPONTANEOUS FISSION RATE AND UPPER MASS LIMIT OF STELLAR NUCLEOSYNTHESIS. Ohnishi, T. (Kyoto Univ.). Phys. Lett.; 47B: No. 3, 227-230(12 Nov 1973).

There is an apparent reduction in the upper limit mass of stellar r-process nuclide when the effect of temperature on spontaneous fission rate is taken into account. The maximum mass number of r-nuclides may not exceed about 290 in this situation. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 7746, 8525, and 8546.

8487 X- AND GAMMA-RAY ASTRONOMY. International Astronomical Union Symposium No. 55 Held in Madrid, Spain, May 11-13, 1972. Bradt, H.; Giacconi, R. (eds.). Boston; R. Reidel Publishing Company (1973). 330p. (CONF-720599-). $30.50.

Separate abstracts were prepared for the 23 papers presented. (WDM)

For abstracts of individual papers see: 8488–8506, 8546, and 8553–8555.

8488 UHURU RESULTS ON GALACTIC X-RAY SOURCES. Tananbaum, H. D. (American Science and Engineering, Cambridge, MA). Int. Astron. Union Symp.; No. 55, 9-28(1973).

From symposium X–and gamma-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Galactic x-ray sources studied by Uhuru can be classified into several categories, including supernova remnants, transient or nova-like sources, Sco X-1 like sources, and pulsating sources. The latter are discussed in some detail with particular emphasis upon the characteristics of the periodic binary x-ray sources, Cen X-3 and Her X-1. It is suggested that all galactic x-ray sources (except S/N remnants) may be binary systems. (auth)

8489 OBSERVATIONS OF COSMIC X-RAY SOURCES BY THE MIT INSTRUMENT ON THE OSO-7. Clark, G. W. (Massachusetts Inst. of Tech., Cambridge). Int. Astron. Union Symp.; No. 55, 29-35(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

The Seventh Orbiting Solar Observatory, OSO-7, carries on board a 1 to 60-keV x-ray detector for the purpose of measuring the positions, spectra, and time variations of x-ray sources. The instrument is described herein, and several topics under investigation and results in publication are mentioned. (auth)

8490 BINARY SYSTEMS AS X-RAY SOURCES: A REVIEW. Kraft, R. P. (Univ. of California, Santa Cruz). Int. Astron. Union Symp.; No. 55, 36-50(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

The observational properties of Sco X-1, Cyg X-2, and Cen X-3 are reviewed in connection with the hypothesis that x-ray power is derived from gravitational energy released when matter is accreted onto the surface of one component in a mass transfer binary star. Evolutionary mechanisms for producing suitable types of binaries are considered. The following boundary conditions on possible evolutionary models are also treated briefly: (1) a quite significant fraction of hard x-ray sources are associated with the nuclear bulge of the Galaxy; (2) mass-transfer binaries such as U Gem stars are not hard x-ray sources; (3) counts of binary stars lead to a considerably larger number of x-ray source candidates than are actually observed. (auth)

8491 HARD COSMIC X-RAY SOURCES. Peterson, L. E. (Univ. of California, San Diego, La Jolla). Int. Astron. Union Symp.; No. 55, 51-73(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

A review of the observational status of x-ray sources detected in the 20 ≃ 500 keV range is presented. Of the approximately 115 sources listed in the March 1972 edition of the Uhuru 2 to 6-keV sky survey catalog, about 15 sources have been studied in hard x rays. Most of the data have been obtained from balloons, although the OSO-3, and more recently the OSO-7, have contributed. With the exception of CEN A, the SMC, and possibly M-87, all the sources detected at higher energies are galactic and heavily concentrated in the galactic plane. The Crab Nebula has been measured to about 500 keV in continuous emission and a component at the ≃33 ms pulsar period comprising about 20% of the total emission has been detected to ~10 MeV. Objects such as Sco-1 and Cyg-2 are characterized by an exponential spectrum, which varies over a 10 min. time scale about a factor of two, and a flatter spectrum extending to above 40 keV which exhibits independent variability. Objects such as Cyg-1 and possibly Cyg-3 have a multi-component power law spectrum extending to over 100 keV, and may vary many factors over a period of weeks. Other sources generally not yet identified with optical or radio candidates, located in the galactic center and the Centaurus/Crux region also show considerable variability, and in one case may have been detected to nearly 500 keV. Only upper limits at about 2×10^{-4} photon $(cm^2\ s\ keV)^{-1}$ in the 20 to 50-keV range exist for most supernova remnants and extragalactic sources. (auth)

8492 SIMULTANEOUS X-RAY, OPTICAL, AND RADIO OBSERVATIONS OF GALACTIC X-RAY SOURCES. Hiltner, W. A. (Univ. of Michigan, Ann Arbor). Int. Astron. Union Symp.; No. 55, 74-85(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Simultaneous observations of the x-ray source Sco X-1 are reviewed and discussed. Several conclusions can be drawn from the observations. (a) There is no correlation of the radio intensities with either the optical or x-ray intensities. (b) The x-ray intensity is high and variable only when the blue optical magnitude is brighter than 12.6 to 12.7. (c) There is often correlation of x-ray and optical flares, but the relationship is not one to one. Attention is called to the paucity of simultaneous observations of other identified x-ray sources. (auth)

8493 RADIO OBSERVATIONS OF X-RAY SOURCES. Braes, L. L. E.; Miley, G. K. (Univ., Leiden). Int. Astron. Union Symp.; No. 55, 86-97(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Observational work on radio emission from galactic x-ray sources is reviewed. Some problems associated with the detection of these weak radio sources are mentioned and the present knowledge of radio identifications is summarized. The radio properties of the most studied objects are discussed in detail. (auth)

8494 RADIO COUNTERPARTS OF X-RAY SOURCES AND X-RAY COUNTERPARTS OF RADIO STARS. Hjellming, R. M.

(National Radio Astronomy Observatory, Green Bank, WV). Int. Astron. Union Symp.; No. 55, 98-104(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Some of the implications of the data on radio counterparts of x-ray sources are discussed. Data on the radio counterpart of Cyg X-3 is compared with the data on the radio star β Persei (Algol), to show that similar radio emission mechanisms are involved. The data for such radio stars not yet known as x-ray sources imply that such objects should be transient x-ray sources. (auth)

8495 X-RADIATION FROM SUPERNOVA REMNANTS. Pounds, K. A. (Univ. of Leicester, Eng.). Int. Astron. Union Symp.; No. 55, 105-117(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Available x-ray observations of supernova remnants are reviewed. The number of SNR seen above 2 keV remains small after inclusion of the Uhuru results and for only the Crab Nebula is the data adequate to clearly indicate the radiation mechanism. The increasing importance of low energy x-ray studies (below 1 keV) of older and relatively nearby remnants is noted. Brief discussion is given of the relation of the x-ray data to current ideas of the evolution of SNR. (auth)

8496 GALACTIC X-RAY POLARIMETRY AND HIGH-RESOLUTION X RAY SPECTROSCOPY. Novick, R. (Columbia Univ., New York). Int. Astron. Union Symp.; No. 55, 118-131 (1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Stellar x-ray spectroscopy and polarimetry are discussed in terms of the source parameters that can be determined through such studies and in terms of the constraints that these studies will place on theoretical models. The spectroscopic and polarimetric results that have been obtained to date are reviewed. These include the recent discovery of x-ray polarization in the Crab Nebula and the recent evidence for x-ray coronal line emission in the Cygnus Loop. Finally, the properties and predicted performance of a number of satellite-borne spectrometers and polarimeters are presented. (auth)

8497 MODELS FOR COMPACT X-RAY SOURCES. Salpeter, E. E. (Cornell Univ., Ithaca, NY). Int. Astron. Union Symp.; No. 55, 135-142(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

A statistical analysis of the Uhuru catalog of x-ray sources leads to the following conclusions. If the weak sources are omitted, there is a strong concentration to low galactic latitude but the absence of a strong background and the presence of some strong sources at low galactic longitude indicate an appreciable number of sources of luminosity $L \sim 10^4\ L_\odot$ in the vicinity of the "nuclear bulge". This region generally suggests "stellar population II" and therefore stars of small mass. However, there is some suggestion of a second class of sources, distributed in the galactic plane like "stellar population I" and suggesting large stellar masses. There are three possible types of simple x-ray spectra, (a) optically thin bremsstrahlung, (b) blackbody spectrum, and (c) power-law spectra. Only theoretical models for type (a) are reviewed, including accretion, rotation and vibration for a white dwarf star and cocoons around a neutron star. (auth)

8498 MODELS FOR COMPACT PULSING X-RAY SOURCES. Ostriker, J. P.; Davidson, K. (Princeton Univ. Observatory, NJ). Int. Astron. Union Symp.; No. 55, 143-154(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Cen X-3 is probably a neutron star, releasing the infall energy of accreted matter. Sufficient material for accretion will be provided by a conventional stellar wind from its more massive companion star. That star is not likely to rotate synchronously; therefore a "Roche lobe" analysis of the eclipses is not valid. A "tidal lobe" analysis allows the neutron star to have a mass of the order of one solar mass. Overflow of the "Roche lobe" is neither necessary as a source of mass nor probable in view of the observed stellar line widths of the two identified x-ray companions. The mass flow onto the condensed star is very small in all cases. It is limited, for an object of m solar masses by the Eddington limiting luminosity to $M_{ac} < 10^{-7.4}\ m(M_\odot\ yr^{-1})$, which limit applies even if the accreting object contacts or traverses its companion star. The observed 4.84 s rotation period of the Cen X-3 neutron star is very simply explained as the critical value where a centrifugal barrier regulates the rate of infall to the surface. The x-ray spectrum is understood as blackbody radiation coming from a well-defined area near each magnetic pole of the neutron star. (auth)

8499 BLACK HOLES IN BINARY SYSTEMS: OBSERVATIONAL APPEARANCES. Shakura, N. I. (State Astronomical Inst., Moscow); Sunyaev, R. A. Int. Astron. Union Symp.; No. 55, 155-164(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

The outward transfer of angular momentum of accreting matter can lead to the formation of a disk around the black hole. The structure and radiation spectrum of the disk depends, in the main, on the rate of matter inflow M into the disk at its external boundary. Dependence on the efficiency of mechanisms of angular momentum transport (connected with the magnetic field and turbulence) is weaker. If $M = 10^{-9}$ to $3 \times 10^{-8}\ M_\odot$/yr, the disk around the black hole is a powerful source of x radiation with $h\nu \sim 1$ to 10 keV and luminosity $L \sim 10^{37}$ to 10^{38} erg s^{-1}. If the flux of the accreting matter decreases, the effective temperature of radiation and the luminosity will drop. At the same time when $M > 10^{-9}\ M_\odot\ yr^{-1}$, the optical luminosity of the disk exceeds the solar one. The main contribution to the optical luminosity of the black hole is due to the re-radiation of that part of the x-ray and ultraviolet energy which is initially produced in the central high-temperature regions of the disk and which is then absorbed by the low-temperature outer regions. The optical radiation spectrum of such objects must be saturated by the broad emission recombination and resonance lines. Variability is connected with the character of the motion of the black hole and the gas flow in binary systems and possibly with eclipses. For well defined conditions, the hard radiation can evaporate the gas. This can counteract the matter inflow into the disk and lead to autoregulation of the accretion. If $M \gg 3 \times 10^{-8}\ (M|M_\odot)\ M_\odot\ yr^{-1}$, the luminosity of the disk around the black hole is stabilized at the critical level of $L_{cr} = 10^{38}\ (M|M_\odot)$ erg s^{-1}. A small fraction of the accreting matter falls under the gravitational radius whereas the major part of it flows out with high velocities from the central regions of the disk. The outflowing matter is opaque to the disk radiation and completely transforms its spectrum. As a consequence, a black hole in a supercritical regime of accretion can appear as a bright star with a strong outflow of matter. (auth)

8500 PULSARS AND X-RAY SOURCES. Pacini, F. (Laboratorio di Astrofisica Spaziale, Frascati, Italy). Int. Astron. Union Symp.; No. 55, 165-167(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Some theoretical aspects of the x-ray emission from genuine pulsars and their relation to the more general problems of x-ray sources are summarized. (auth)

8501 UHURU RESULTS ON EXTRAGALACTIC X-RAY SOURCES. Kellogg, E. M. (American Science and Engineering, Cambridge, MA). Int. Astron. Union Symp.; No. 55, 171-183(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Data from the Uhuru satellite have provided a list of more than forty high-latitude sources ($|b|>20°$). X rays have been detected from among the nearest normal galaxies, giant radio galaxies, Seyferts, QSOs, and clusters of galaxies. The cluster sources appear to be extended by several hundred kiloparsecs as well as being very luminous. These cluster sources have systematic differences in their x-ray spectra from individual galaxies. About twenty sources are not reliably identified so far. A few of these are located near undistinguished 3C or MSH radio sources. The rest are either located near distant clusters or undistinguished bright galaxies, or are too far south, so that we have not sufficient optical data to allow a thorough search for possible association with clusters or unusual individual galaxies. The luminosity function for weak, high-latitude x-ray sources is determined, and the contribution of sources just below the Uhuru threshold of detectability to observed fluctuations in the diffuse x-ray background is evaluated. The total contribution of all observed types of extragalactic sources to the x-ray background is estimated. (auth)

8502 PROPERTIES OF EXTRAGALACTIC X-RAY SOURCES FROM VISIBLE LIGHT OBSERVATIONS. Sargent, W. L. W. (California Inst. of Tech., Pasadena). Int. Astron. Union Symp.; No. 55, 184-198(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

The optical properties of the radio galaxy NGC 5128, the Seyfert galaxy NGC 4151, and the QSO 3C 273 all of which appear to be point sources of x-rays are described and it is emphasized how the x-ray observations, particularly the low energy absorption cutoff, may help us to understand the detailed structure and source of energy in these diverse objects. The clusters of galaxies in

Virgo, Perseus, Coma, and Centaurus, all associated with extended x-ray sources are described. They have diverse shapes, central concentrations, and galactic populations, but all contain a radio galaxy and, in several cases, a low frequency radio halo around it. It is concluded that the x-ray emission is likely to be nonthermal in origin. (auth)

8503 EXTRAGALACTIC X-RAY SOURCES. Burbidge, G. R. (Univ. of California, San Diego, La Jolla). Int. Astron. Union Symp.; No. 55, 199-207(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

A review is given of the physical properties of extragalactic x-ray sources. The generation of x rays as thermal bremsstrahlung, by the synchrotron mechanism, or by Compton scattering, is discussed. It is shown that each may be important depending on the circumstances. Only more detailed observations will enable one to decide which process dominates in any given source. (auth)

8504 EXTRAGALACTIC X-RAY SOURCES AND THEIR CONTRIBUTION TO THE DIFFUSE BACKGROUND. Setti, G. (Univ., Bologna); Woltjer, L. Int. Astron. Union Symp.; No. 55,, 208-211(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Estimates of the integrated contribution of extragalactic sources to the diffuse x-ray background in the 2 to 10-keV energy interval are presented. It appears that classes of objects already detected as x-ray sources easily account for at least 10% of the background. Quasistellar objects, and possibly Seyfert and radio galaxies might contribute a larger fraction of the background intensity. It is also suggested that several of the unidentified x-ray sources in the Uhuru catalog at high galactic latitudes may be bright QSO's as yet unknown. The detection of a larger number of QSO's in the x-ray band may allow a decisive test for the cosmological interpretation of the redshifts of QSO's. (auth)

8505 SOFT X-RAY BACKGROUND. Friedman, H. (Naval Research Lab., Washington, DC); Fritz, G.; Shulman, S. D.; Henry, R. C. Int. Astron. Union Symp.; No. 55, 215-234(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

A survey of soft x-ray background observations in the 0.1 to 10-keV range is presented. In the region above 1 keV, recent results on point x-ray sources are discussed and their integrated contribution to the diffuse background is estimated. However, the average luminosity of various classes of extragalactic x-ray sources is still not sufficiently well known to permit this estimate to be made with any certainty. A discussion is given of recent observations at energies below 1 keV where the effects of interstellar absorption are important. It is argued that although some fraction of the background radiation in the 0.1 to 1-keV range must be galactic in origin, there is still substantial evidence for an extragalactic component. Proposed theories for generating both the galactic and extragalactic x-ray background are briefly reviewed. (auth)

8506 HIGH-ENERGY DISCRETE SOURCES. Fazio, G. G. (Smithsonian Astrophysical Observatory, Cambridge, MA). Int. Astron. Union Symp.; No. 55, 303-323(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

The origin of the gamma radiation from the galactic plane and the region near the galactic center is still uncertain. However, during this meeting, several groups reported evidence for discrete sources of cosmic gamma rays. Most of the sources are located near the galactic plane, and some are associated with x-ray sources. The galactic gamma radiation may be due to these previously unresolved sources. Other sources detected may be associated with variable radio galaxies. The Crab Nebula still remains the most investigated source at γ-ray energies. Pulsed emission from NP 0532 was detected in the 10- to 30-MeV region, but no continuous emission was observed. At the highest energies, pulsed emission was reported at $\sim 10^{12}$ eV. Continuous emission from the Crab Nebula was observed at $\sim 10^{11}$ eV; the radiation may be time variable. The recent γ-ray experiments on Apollo 15 and 16 and the ESRO satellite TD-1 are described, as well as future experiments on the satellites SAS-B, COS-B, and HEAO-B. (auth)

8507 STRUCTURE OF COMPACT RADIO SOURCES AT 606 MHz. Purcell, G. H. Jr. Pasadena, CA; California Inst. of Tech. (1973). 214p. Microfilms Order No. 73-26,476.

Thesis (Ph. D.).

Long-baseline interferometry was used to study the structure of thirteen compact radio sources at 606 MHz. The baseline was 3324 kilometers long and nearly east–west in orientation, so that the maximum angular resolution was about a hundredth of a second of arc for each source. There were two series of observations, made on June 29 to July 1, 1971, and February 3 to 6, 1972. For most of the sources observed in each session, the correlated flux was measured from ten to forty times over a wide range of hour angle, with a standard error for each measurement of about 0.12 flux unit. A few sources were observed less often. Simple source models were then fitted to the data and compared to the models proposed by other observers. The data for most of the sources were found to be consistent with models containing an elliptical halo concentric with an unresolved core. 3C 147, 3C 273, and 3C 279 appear to be more complicated, however. The observations of 3C 84, 3C 279, and 3C 345 also show evidence of weak structure at relatively large distances from the strong central components. P1345 + 12 and CTD 93 were observed only in the first session, and 3C 120 and 3C 286 only in the second session. CTA 21, 3C 84, 3C 147, 3C 273, 3C 279, 3C 345, 3C 380, CTA 102, and 3C 454.3 were observed in both sessions, and all but CTA 21 and 3C 380 gave strong evidence of changes in flux or structure during the interim. These changes appear to be intrinsic to the sources, and not the result of instrumental effects or scintillation phenomena. (Diss. Abstr. Int., B)

8508 POLARIZATION OBSERVATIONS OF 3C RADIO SOURCES AND GALACTIC FARADAY ROTATION. Wright, W. E. Pasadena, CA; California Inst. of Tech. (1973). 175p. Microfilms Order No. 73-26,479.

Thesis (Ph. D.).

The linear polarization properties of 206 radio sources from the 3CR Catalogue were measured—in most cases at 21, 18, and 6 cm. The observing scheme also allowed the establishment of upper limits for the degree of circular polarization. The Owens Valley Radio Observatory 90′ interferometer was used for these observations. With the use of all available data, the Faraday rotation measures of 354 radio sources, mostly extragalactic, were computed. Searches for correlations between rotation measure and source type, depolarization, or redshift all led to negative results. The upper limit for a uniform, linear component of the intergalactic magnetic field, based on the failure of the last correlation, was $n_eB < 2 \times 10^{-13}$ cm^{-3} gauss. (Diss. Abstr. Int., B)

8509 X-RAY ASTRONOMY. Friedman, H. (Naval Research Lab., Washington, DC). pp 315-335 of Fundamental Interactions in Physics. Perimutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

The topics discussed are supernovae and neutron stars, Sco X-1, x-ray sources in binary systems, extragalactic sources, diffuse x rays, the very soft x-ray background, clusters of galaxies, and matter and antimatter. (JFP)

8510 PULSARS. Encrenaz, P. (Paris Observatory, Meudon, France). Bull. Union Physiciens; 67: No. 557, 1125-1141 (Jul 1973). (In French).

The techniques used to establish the existence of pulsars are discussed together with their limitations. The principal characteristics of pulsars are recalled: galactic distribution, periods, shapes of the pulses, and distances. (FR)

8511 ANGULAR DISTRIBUTION OF COMPLETE SAMPLES OF BRIGHT QUASI-STELLAR AND UNIDENTIFIED RADIO SOURCES. Plagemann, S. H. (Dunsink Observatory, Castleknock, Ireland). Mon. Notic. Roy. Astron. Soc.; 164: No. 3, 303-319 (1973).

Using a variant of Fisher's method of analysis of dispersion on a sphere, a study is made of the angular distribution on the sky of various complete samples of unidentified and quasi-stellar radio sources (QSRs) from the 3C and Parkes catalogues. Samples chosen by redshift, apparent optical brightness, and radio dimension do not show evidence of gross departures from a uniform random distribution. Statistical analysis does not confirm Arp's suggested association of optically faint QSRs with the brighter galaxies in the Shapley–Ames catalogue. However, evidence is found of a strong anisotropy in the distribution of 3C blank field radio sources. In addition, the bright compact QSRs with flat radiospectral indices are anisotropically distributed along the axis of the Local Supercluster at high galactic latitudes. This class of QSRs shows unusual optical and radio variability, and associations with Arp's peculiar galaxies and Zwicky clusters of galaxies. Thus difficulties may arise in the interpretation of a composite log N–log S curve of radio sources, because its validity depends on assumptions of spatial homogeneity and isotropy at all flux levels. (auth)

8512 BRAGG SPECTROSCOPY OF SCORPIUS X-1 IN SEARCH OF THE Fe-XXV EMISSION LINES. Stockman, H. S. Jr.

Columbia, NY; Columbia Univ. (1973). 137p. University Microfilms Order No. 73-28,504.

Thesis (Ph. D.).

An experiment employing a large-area LiF crystal spectrometer was flown aboard an Aerobee - 170 sounding rocket in search of x-ray line emission from Sco X-1. A measurement of the spectrum between 6.73 and 6.65 keV showed no evidence of either emission or absorption features. The results for the Fe XXV resonance (6.70 keV), intercombinational (6.68 keV), and forbidden (6.65 keV) lines' equivalent widths were 1.1 ± 1.6, -0.1 ± 1.6, and 0.4 ± 2.1 eV, respectively. These values are a hundred-fold smaller than the predicted line strengths for an optically thin plasma. A plasma model involving source thicknesses of many electron scattering lengths was adopted; and its compatibility with current dynamic models for Sco X-1 is discussed. The instrument, flight program, and the data analysis are described in detail. (Diss. Abstr. Int., B)

8513 RADIO WAVES OF THE CASSIOPEIA-A SUPERNOVA REMNANT. Stankevich, K. S.; Ivanov, V. P.; Pelyushenko, S. A.; Torkhov, V. A.; Ivannikova, A. N. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 786-798(1973). (In Russian).

Absolute measurements on the intensity of the powerful discrete sources of Cassiopeia-A and Lebed-A were repeated in an effort to improve the measurement method. The radiotelescope used, with a 7 m-dia parabolic reflector, permitted measurements at wavelengths from 3 to 30 cm. (TTT)

8514 TWO MORE COMPACT H II-FIELDS. Pariiskii, Yu. N.; Glushkov, Yu. I. (Special Astrophysical Observatory, Leningrad). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 778-780(1973). (In Russian).

Characteristics of the subject fields are tabulated. (auth)

8515 DISTRIBUTION OF THE RADIO INTENSITY IN THE CRAB NEBULA IN THE CENTIMETER AND MILLIMETER RANGES. Matveenko, L. I. (Inst. of Cosmic Studies, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 781-783(1973). (In Russian).

The radio-wave field of the Crab Nebula is approximately elliptical. It is within the optically visible limits and practically coincides with them. The intensity drops sharply at the limits except in the eastern part at 3.5-cm wavelength, which is outside the optically visible limits. Because of the low intensity, observations at other wavelengths are difficult. The center of gravity of individual scans lies on an S-shaped curve. Isophote data plots for 1.28-cm and 3.5-mm waves are shown. (TTT)

8516 PRELIMINARY RESULTS OF OBSERVATIONS OF THE NEBULA IN ORION AT SUBMILLIMETER WAVES. Kislyakov, A. G.; Listvin, V. N.; Chernyshev, V. I.; Shvetsov, A. A. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 774-777(1973). (In Russian).

Values observed for flux density of Orion-A radiation indicated a source with $\alpha_{1950} = 5$ hr 31 min 26 sec $\pm$ 5 sec. A rough evaluation of the inclination is $\delta_{1950} = 5°25' \pm 15'$. No Orion-A radio waves were observed. The upper limit for the density was around 300×10^{-26} W/m^2 Hz, which is consistent with the value of 270×10^{-26} W/m^2 Hz at $\lambda = 1.2$ mm extrapolated from earlier reported infrared data. (TTT)

8517 DISCRETE SOURCES AT 2-CM WAVELENGTH OBSERVED AT PULKOVO. Bogod, V. M.; Golubchina, O. A.; Mirovskii, V. G.; Pyatunina, T. B.; Soboleva, N. S.; Strukov, I. A.; Fridman, P. A. (Special Astrophysical Observatory, Leningrad). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 765-773(1973). (In Russian).

Observation of the coordinates of the maximum of 2.04-cm radiation from 3C 273 and two components of Lebed-A indicated an eastward displacement from the optical center of $17'' \pm 10''$, i.e., in the direction of the new optical burst described by Arp (Astrophys. Lett. 1(1), 1967). This value does not agree with values at other wavelengths. At 21 cm, the maximum coincides with the center and at 3 cm is displaced 7'' to the west and coincides with the optical burst. (auth)

8518 POLARIZATION CHARACTERISTICS OF RADIO WAVES OF PULSARS SR 0950 AND SR 1133 AT 3.5-M WAVELENGTH. Alekseev, Yu. I. (Lebedev Inst. of Physics, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 762-764(1973). (In Russian).

Measurements of polarization pulses indicated almost linear polarization of the SR 0950 waves. SR 1133 waves come from two different regions with different characteristics. (TTT)

Solar Phenomena

Refer also to abstracts 8469, 8476, 8549, 8575, 8580, 8581, 8595, and 8599.

8519 OUTFLOW OF CHROMOSPHERIC EMISSION FEATURES FROM THE RIM OF A SUNSPOT. Liu, S. Y. (High Altitude Observatory, Boulder, CO). Solar Phys.; 31: No. 1, 127-129(Jul 1973).

In order to study the temporal behavior of fine structure in the solar chromosphere, time-lapse sequences of spectroheliograms were obtained in the violet emission peak (K_{2v}) of Ca II λ 3933. Such a time-lapse sequence taken with the 36 cm image of the McMath Telescope at the Kitt Peak National Observatory was shown. The spatial resolution approaches one second of arc and the temporal resolution is 45s/frame for a duration of 1 h and 35 min. The spectroheliograph bandpass is 0.12Å centered at 0.18Å to the violet of the K_3 line core. (MHR)

8520 VARIATIONS OF THE RELATIVE ABUNDANCES OF He, (C, N, O) AND Fe-GROUP NUCLEI IN SOLAR COSMIC RAYS AND THEIR RELATIONSHIP TO SOLAR PARTICLE ACCELERATION. Bertsch, D. L.; Biswas, S.; Fichtel, C. E.; Pellerin, C. J.; Reames, D. V. (Goddard Space Flight Center, Greenbelt, MD). Solar Phys.; 31: No. 1, 247-257(Jul 1973).

Measurements of the flux of helium nuclei in the 24 January, 1971, event and of helium and (C, N, O) nuclei in the 1 September, 1971, event are combined with previous measurements to obtain the relative abundances of helium, (C, N, O), and Fe-group nuclei in these events. These data are then summarized together with previously reported results to show that, even when the same detector system using a dE/dx plus range technique is used, differences in the He/(C, N, O) value in the same energy/nucleon interval are observed in solar cosmic ray events. Further, when the He/(C, N, O) value is lower the He/(Fe-group nuclei) value is also systematically lower in these large events. When solar particle acceleration theory is analyzed, it is seen that the results suggest that, for large events, Coulomb energy loss probably does not play a major role in determining solar particle composition at higher energies (> 10 MeV). The variations in multicharged nuclei composition are more likely due to partial ionization during the acceleration phase. (auth)

8521 CHEMISTRY OF THE SOLAR NEBULA. Larimer, J. W. (Arizona State Univ., Tempe). Space Sci. Rev.; 15: No. 1, 103-119(Sep 1973).

The composition, mineralogy, and texture of chondritic meteorites suggest they are relatively unaltered relicts of the condensation and accretion processes which took place in the primitive solar nebula. Chondrites thus are thought to contain a unique record of the physico-chemical conditions which prevailed at the time and place (asteroid belt) of their origin. Elemental abundance patterns are an important clue to the events and processes. Most elements can be placed in one of four groups according to their observed fractionation behavior in chondritic material; refractory, siderophile, normally depleted, and strongly depleted. This grouping can be explained in terms of four events which presumably took place during cooling, condensation, and accretion in the nebula. In order of inferred occurrence these are: (1) partial loss of the initial condensates rich in refractory elements at T > 1300K, (2) partial loss of metallic Fe–Ni grains, perhaps because they were magnetic, at 1000 to 700 K, (3) partial remelting and outgassing of the condensate (chondrule formation) at 600 to 350 K, and (4) accretion, when the P–T conditions controlled the volatile content (500 to 350 K). Total gas pressure at the time and place of accretion is estimated to fall between 10^{-3} and 10^{-4} atm. (auth)

8522 ABUNDANCES OF THE ELEMENTS IN THE SOLAR SYSTEM. Cameron, A. G. W. (Yeshiva Univ., NY). Space Sci. Rev.; 15: No. 1, 121-146(Sep 1973).

The present status of abundance information for elements in meteorites and in the Sun is reviewed, and a new table of abundances of the elements, which should be characteristic of the primitive solar nebula, is compiled and presented. Special attention is called to the elemental abundances in the silicon-to-calcium region, where many of the abundances are rather poorly determined, and where these abundances have an impact on theories of nucleosynthesis of the elements. To each elemental isotope is assigned a mechanism of nucleosynthesis which may have been responsible for production of most of that isotope, and brief comments are made concerning the present status of understanding of the different mechanisms of nucleosynthesis. (auth)

8523 ACHONDRITIC URANIUM. Fisher, D. E. (Univ. of Miami, FL). Earth Planet. Sci. Lett.; 20: No. 1, 151-156(Sep 1973).

Uranium was measured by homogenized fission track analysis in 34 samples of 22 achondrites. Potassium was determined in aliquots of eleven of these. The results, combined with previous Al data, were not compatible with achondrite formation from chondritic material by previously suggested fractional melting or metal-sulfide segregation processes. (auth)

8524 OBSERVATION OF THE ABSOLUTE INTENSITY AND THE CENTER-TO-LIMB VARIATIONS OF THE SUN IN THE VACUUM ULTRAVIOLET REGION. Nishi, K. (Tokyo Univ., Mitaka, Japan); Higashi, K.; Yamaguchi, A.; Suemoto, Z. Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 9: No. 2, 359-376(May 1973). (In Japanese).

The absolute intensity and the center-of-limb variations of the Sun in the vacuum ultraviolet region were observed by the K-10-6 rocket flown from Uchinoura, Japan, on September 1, 1971, 1110 JST. The nose cone of the rocket was controlled to point in the direction of the Sun by a jet system within about ±20′. A trichrometer was used for the measurements, and the measured wavelengths were 1.629 A, 1.684 A, and 1.739 A. The spatial and spectral resolutions were 1.3 and 8.3 A, respectively. The observed results were compared with some solar models and seem to fit best to the HSRA (Harvard Smithsonian Reference Atmosphere). (auth)

8525 LOG-PERIODIC ARRAY AT THE CLARK LAKE RADIO OBSERVATORY. Erickson, W. C.; Kuiper, T. B. H. (Univ. of Maryland, College Park). Radio Sci.; 8: No. 10, 845-853(Oct 1973).

A log-periodic array, three km in length, is operating at Clark Lake Radio Observatory. It makes one-dimensional sweeps of the solar brightness distribution in the frequency range 20 to 65 MHz once per sec. The phasing of the array and the receiving system are described, as well as how the dynamic spectra are analyzed for the positions of solar radio sources. Simultaneous measurements at many frequencies enable the observer to remove the effects of ionospheric refraction and to obtain fundamental positions to an accuracy of about one arc min at decametric wavelengths. Fundamental positions are given for Cassiopeia A. (auth)

8526 ALTERATIONS OF THE ISOTOPIC COMPOSITIONS OF THE NOBLE GASES BY NUCLEAR ASTROCHEMICAL PROCESSES. Thompson, R. H. Fayetteville, AR; Univ. of Arkansas (1973). 107p. University Microfilms Order No. 73-27,402.

Thesis (Ph. D.).

The isotopic compositions of the noble gases vary markedly within the solar system. Some of the sources of alterations are: (a) cosmic-ray spallation reactions, and (b) the decay of ^{40}K. In the case of radioactive minerals nuclear reactions such as $^{18}O(\alpha,n)^{21}Ne$, $^{19}F(\alpha,n)^{22}Na \xrightarrow{\beta^+} {}^{22}Ne$, and $^{35}Cl(\alpha,p)^{38}Ar$ enter the picture. It is very difficult however, to accept the view that the nuclear reactions alone are the principal cause of the variations of neon and argon isotope ratios within the solar system. The isotopic compositions of the rare gases released from the meteorite Bruderheim and the krypton and xenon released from the dark portion of the Potter meteorite were determined mass-spectrometrically in a stepwise heating experiment. The neon data can be best interpreted on the basis of Manuel's 1967 postulate (Geochim. Acta 31, 2413) that the neon consists of three components (a) cosmic-ray produced, (b) primordial, and (c) mass-fractionated primordial gas. The argon and krypton data can be similarly explained on the basis of three components (a), (b), and (c) mentioned above, plus the addition of excess ^{40}Ar from the decay of ^{40}K. The xenon data is also explained by components (a), (b), and (c) plus excess ^{129}Xe from the decay of ^{129}I and a component (f) to include the fissiogenic xenon from the well established contribution of the spontaneous fission of ^{244}Pu. An equation used by Aston ("Mass-Spectra and Isotopes," pg. 220, 1933) enables one to calculate the extent to which the primordial rare gases can be mass fractionated within the solar system. (Diss. Abstr. Int., B)

8527 ABSOLUTE BRIGHTNESS TEMPERATURE MEASUREMENTS AT MILLIMETER WAVELENGTHS. Ulich, B. L. Austin, TX; Univ. of Texas (1973). 146p. University Microfilms Order No. 73-26,098.

Thesis (Ph. D.).

Absolute brightness temperatures of the Sun, Moon, Mercury, Venus, Mars, Jupiter, and Saturn were measured at three millimeter wavelengths with a 4.88 meter diameter radio telescope. These and other data are used to determine the shape and absolute intensity of the millimeter spectra of the planets and are interpreted in terms of existing surface and atmospheric models. Radiative conduction in the Mercurian epilith is shown to be a relatively unimportant method of heat transfer in the region where the millimeter emission originates. The existence of a thin layer of liquid water in the Martian topsoil is shown to be highly unlikely. The presence of apparent resonant absorption feature in the spectrum of Venus near 2 mm wavelength has been confirmed. An unexpectedly high brightness temperature of Jupiter near 3 millimeters wavelength produces a complex millimeter spectrum. The spectrum of Saturn is flat at short millimeter wavelengths and thus Saturn is the best planetary calibration source for relative measurements. A previously unidentified deep absorption feature has been found in the solar continuum near 8 mm wavelength. Special observations of the Sun, Moon, and DR21 confirm the accuracy of the absolute calibration of the radio telescope and radiometers. (Diss. Abstr. Int., B)

8528 OBSERVATIONS OF FLUCTUATIONS OF RADIO WAVE STREAMS FROM THE SUN AT A 3.2-CM WAVE. Gontarev, O. G. Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 719-722(1973). (In Russian).

Measurements of fluctuations in radio wave streams in the ionosphere over Kazakhstan were started in 1971. Some periodicity was indicated, with maximums having periods of 960 and 750 sec. Maximums of shorter periods were much smaller in amplitude and appeared less often. An explanation of the discreteness of the fluctuation spectra is difficult. However, if the fluctuations are considered due to intrinsic variations in individual particles of the solar atmosphere, the presence of maxima may be explained by the spatial scale of the chromosphere or coronal formations. (TTT)

8529 SOLAR RADIATION CHANGES AND THE WEATHER. King, J. W. (Science Research Council, Slough, Eng.). Nature (London); 245: No. 5426, 443-446(26 Oct 1973).

It is suggested, on the basis of pressure measurements, that energetic solar particles which penetrate the atmosphere in the North Atlantic region may be responsible, in some unknown manner, for certain meteorological variations. (auth)

8530 MeV ELECTRONS, PROTONS, AND ALPHA PARTICLES OBSERVED AUGUST 2-12, 1972. Page, D. E.; Domingo, V.; Wenzel, K. P. (European Space Research and Tech. Center, Noordwijk, Netherlands). (1973). vp.

From seventh ESLAB symposium; Saulgau, Germany (22 May 1973).

Electrons, protons, and alpha particles were monitored in an experiment on the ESRO satellite HEOS-2 during the August 1972 solar particle events. Electrons were measured in the energy range 0.45 to 3.5 MeV, protons and alpha particles in the energy range 9.3 to 35.7 MeV/N. The recorded particle intensities are described in detail, with special emphasis on the time behavior of the particle fluxes. (GE)

8531 MEASUREMENTS OF THE FREQUENCY SPECTRUMS OF RADIO WAVES OF THE SUN IN THE RANGE 6200 TO 7100 MHz. Belov, I. F.; Vaulina, L. A.; Divakova, E. K.; Kobrin, M. M.; Korshunov, A. I.; Lebedev, E. I.; Nedeshev, Yu. S.; Timofeev, B. V. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 723-726(1973). (In Russian).

Using a specially designed spectrograph, measurements were made on the subject waves. The results showed that the frequency spectra have a considerably more complex nature than might have been thought based on observations of discrete frequencies. In most cases the spectra had a well expressed minimum in the range 6700 to 6900 MHz. The discovery of a fine structure of the frequency spectra of radio waves from the Sun provided information on the physical peculiarities and dynamic processes occurring in the active regions of the Sun and on the structure of these regions. (TTT)

8532 PROTON BURSTS AND SOUND STORMS. Levitskii, L. S. (Crimean Astrophysical Observatory, Moscow). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 727-730(1973). (In Russian).

Proton bursts caused an increase in the 200-MHz radio wave stream which lasted as much as a day. The sound storm increased approximately a day before the beginning of the proton burst, and the average intensity of the sound storm was somewhat greater after the proton burst than before. The average intensities of the sound storms differed little for proton regions of different strengths. (auth)

8533 NEW EVALUATION OF THE HEIGHTS OF LOCAL SOURCES OF SLOWLY CHANGING COMPONENTS OF RADIO WAVES OF THE SUN AT 3.2 CM WAVELENGTH. Borovik, V. N.; Gel'freikh, G. B.; Lubyshev, B. I. (Special Astrophysical Observatory, Leningrad). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 731-736(1973). (In Russian).

Three different groups of spots examined, indicated heights of approximately the same value. It is considered that small spots, with an average small magnetic field, do not penetrate to the corona at a level necessary for formation of an intense radiation source at a 3.2-cm wavelength. (TTT)

8534 POSSIBLE STATISTICAL ANALYSES FOR STUDYING B AND S COMPONENTS OF RADIO WAVES OF THE SUN. Arbuzov, S. I.; Korshunov, A. I.; Fridman, V. M. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 737-741(1973). (In Russian).

Data on the radiation (radiowave) levels of the "quiet" Sun were studied from the dependence of the polar streams of radio waves on surface spots. Values for the B component found by extrapolation of the surface spots to zero, differed no more than 5% from values obtained by a histogram. Analysis of the data showed that, in 70% of the cases, there was a sharp decrease in the gradient of the spectrum in the 3- to 8-cm range a day or two before a burst, and in many cases there was a negative gradient. (TTT)

8535 POSSIBILITY OF INFERRING THE SOLAR AND INTERPLANETARY SECTOR STRUCTURE FROM STATISTICS OF GEOMAGNETIC STORMS AND SOLAR ACTIVITY. Gulbrandsen, A. Planet. Space Sci.; 21: No. 11, 2003-2011(Nov 1973).

Attention is drawn to the great statistical material on geomagnetic storms and solar activity, published mainly before the space age. By analyses of this material in connection with established correlations between geomagnetic activity and the interplanetary sector structure, valuable information might be obtained that would significantly contribute to an increased understanding of solar and interplanetary sector magnetism. As an illustration of this, different analyses of solar–geomagnetic correlations have been considered in relation to the paper by Wilcox and Colburn (J. Geophys. Res.; 77: 751 (1972)) on the observed sector structure. Indications are found that (a) the interplanetary and solar sector pattern in the years 1919 to 1969 consisted of mainly 2 or 4 sectors per solar rotation, and (b) sector boundaries are related to bipolar magnetic regions on the Sun. (auth)

8536 TURBULENT ACCELERATION OF ELECTRONS IN SOURCES OF MOVING TYPE IV RADIO SURGES. Zaitsev, V. V. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 742-746(1973). (In Russian).

The front of a shock wave activates the succeeding Type IV extended source, possibly because of an anomously rapid heating and acceleration of electrons at the front of the shock wave due to a plasma turbulence. As a result, there is an expansion of the loop of a nonisothermal plasma with high-energy electrons. Fast electrons are captured in a trap and, when sufficiently heated, begin to generate a Type IV wide-band diffusion surge. If the energy of the electrons accelerated by the plasma turbulence is insufficient for this, the shock-wave front may act as an injector for subsequent further acceleration of electrons. Plasma turbulence is generated at the shock-wave front by current instability when the rate of the relative drift of electrons and ions begins to increase the thermal velocity of the electrons. The electrons captured in the trap cannot emit synchrotron radiation. (TTT)

8537 QUASI-PERIODIC COMPONENTS WITH 30- TO 60-MIN PERIODS IN THE FLUCTUATION SPECTRA OF 3-CM RADIO WAVES OF THE SUN. Aleshin, V. I.; Kobrin, M. M.; Korshunov, A. I. (Scientific-Research Radiophysics Inst., Gorky, USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 747-753(1973). (In Russian).

A mathematical development and graphs are presented along with a discussion of the subject radiowave components. (TTT)

8538 DIATOMIC MOLECULES IN FACULA MODELS. Tripathi, B. M.; Pande, M. C. (Uttar Pradesh State Observatory, Naini Tal, India). Bull. Astron. Inst. Czech.; 24: No. 5, 296-298 (1973).

Results of the dissociation equilibrium calculations in three facula models indicate that more molecules form in the 7B2J Chapman model. Equivalent width calculations in 7B2J model show that the CO^+ lines of (0–3) band of the transition $A^2\Pi_i - X^2\Sigma^+$ and the lines of MgH (0–0) band belonging to the transition $A^2\Pi - X^2\Sigma^+$ should not be detectable in the facular spectrum. (auth)

8539 DEVELOPMENT AND SPATIAL STRUCTURE OF THE PROTON FLARES NEAR THE LIMB AND CORONAL PHENOMENA. VI. Heights of Impulsive Radio and X-Ray Emission Sources for Events from November 2, 1969 and September 1, 1971. Krivsky, L. (Astronomical Inst., Ondrejov, Czech.); Krueger, A. Bull. Astron. Inst. Czech.; 24: No. 5, 291-295(1973).

Drawing on the knowledge of the general properties of proton flares and limb events as observed in H-alpha, radio, and x-ray emissions, the proton flare of November 2, 1969, located beyond the limb, was analyzed in order to derive emission heights and structures for the sources of different electromagnetic wave components as a function of time during the rise of the explosive phase. The analysis supports the assumption that expanding arch structures are also present in the Type IV μ burst emission, whereas the H-alpha emission indicates the lower envelope of the arch system. Source diameters and velocities of expansion were derived from optical and microwave observations. In contrast to the smaller spatial extent of the source of the explosive phase emission, the gradual radio and soft x-ray emissions, at least if accompanying Type IV events, appear to originate in larger volumes. (auth)

8540 27-DAY RECURRENT EFFECTS IN THE DIURNAL ANISOTROPY OF GALACTIC COSMIC RADIATION AND ACTIVE SOLAR REGIONS. Pathak, P. N. (Physical Research Lab., Ahmedabad, India). Indian J. Radio Space Phys.; 2: No. 1, 54-64(Mar 1973).

During a period of 30 solar rotations from August 1962 to November 1964, the 27-day recurrent effects in the observed diurnal anisotropy of the galactic cosmic radiation have been examined. It is shown that, on the average, the amplitude of the diurnal anisotropy decreases in association with 27-day recurrent decreases of the cosmic-ray mean intensity and M-region geomagnetic storms. The observed recurrent effects are found to be well correlated with the longitudinal distributions of long-lasting Ca plages and of the coronal active regions having enhanced λ5303 emission. It is suggested that the observations can be understood in terms of corotating shocks in the interplanetary space that are produced as a result of the interaction between fast and slow solar-wind streams. The reduction in the amplitude of the diurnal anisotropy is suggested to be due to an increase in the ratio of the coefficients of cosmic-ray diffusion perpendicular and parallel to interplanetary magnetic-field direction. It is suggested that various recurrence periods observed in cosmic-ray modulation or geomagnetic activity can be directly related to the number of active regions on the Sun. (auth)

8541 SOLAR WIND HEAT TRANSPORT IN THE VICINITY OF THE EARTH'S BOW SHOCK. Feldman, W. C.; Asbridge, J. R.; Bame, S. J.; Montgomery, M. D. (Los Alamos Scientific Lab., NM). J. Geophys. Res.; 78: No. 19, 3697-3713(1 Jul 1973).

Electron heat flux conducting towards the Sun was observed for 37% of the time from March 18 to June 12, 1971, by the LASL Imp 6 plasma probe. Such an effect is naturally explained in terms of hot electrons streaming away from the bow shock along the interplanetary magnetic field line. These electrons appear as a shoulder enhancement with a well-defined low-velocity cutoff on the unperturbed electron velocity distribution. A few simple cases of observed abrupt reversals in heat flux direction on April 27, 1971, are consistent with an interpretation of the low-velocity cutoff in terms of the time interval between connection of a magnetic field line with the bow shock and intersection with the spacecraft. During intervals of detection of backstreaming electrons, the temperature and anisotropy of the upstream electron component are observed to increase by $\simeq$16% and $\simeq$6%, respectively. Unexpectedly, the magnitude of the heat flux driven back towards the Sun by the Earth's bow shock is usually less than or equal to twice the heat flux driven by the interplanetary thermal gradient. In other words, the net heat flux before and after connection of a magnetic field line with the bow shock remains nearly the same. This indicates that sometimes the undisturbed electron heat conductivity of the interplanetary plasma is saturated. More precisely, the mean value of the dimensionless electron heat flux conducted by the undisturbed interplanetary plasma is observed to be $\simeq$0.21 and to be nearly independent of the electron temperature. (auth)

8542 SIMULATION OF DRIVEN FLARE-ASSOCIATED DISTURBANCES IN THE SOLAR WIND. De Young, D. S. (National Radio Astronomy Observatory, Green Bank, WV); Hundhausen, A. J. J. Geophys. Res.; 78: No. 19, 3633-3642(1 Jul 1973).

The dynamics of nonspherical flare-associated disturbances are considered when the outflow of energetic material at 0.1 AU, which gives rise to the disturbance, is maintained for an arbitrary period of time. The propagation of such disturbances into the interplanetary medium is examined under conditions of different total disturbance energies, energy flux densities, and sizes of the disturbance region at 0.1 AU. The development of these disturbances is followed by using numerical solutions of time dependent two-dimensional hydrodynamic flow in spherical coordinates. Decreasing the total disturbance energy by reducing its duration produces an increase in transit time to 1 AU, ranging from ~37 hours for $E_{tot} = 2.9 \times 10^{32}$ ergs to 58 hours for $E_{tot} = 2.8 \times 10^{30}$ ergs, all for disturbances contained initially in a cone of a half angle equal to 15°. Variation of energy flux density at 0.1 AU shows that disturbances of constant total energy propagate to 1 AU more slowly as the flux density at 0.1 AU decreases. Disturbances that differ only in the area that contains the outflow at 0.1 AU reflect this condition in the shock front shapes at larger heliocentric distances, smaller initial areas resulting in shock fronts with a smaller radius of curvature at 1 AU. (auth)

8543 ALFVEN WAVES IN THE SOLAR WIND: WAVE PRESSURE, POYNTING FLUX, AND ANGULAR MOMENTUM. Hollweg, J. V. (Max Planck Institut fuer Physics und Astro-

physik, Garching, Ger.). J. Geophys. Res.; 78: No. 19, 3643-3652(1 Jul 1973).

Three effects of Alfvén waves propagating in the solar wind are considered. (1) Modification of the angular momentum balance of the solar wind by Alfvén waves in the presence of thermal anisotropy is considered. The Alfvén waves are found to reduce the azimuthal velocity v_ϕ at 1 AU. This effect occurs because the Alfvén waves are transverse and represent an additional component of the pressure perpendicular to the magnetic field. The effect is large if $\langle \delta B^2 \rangle / B_0^2 \gtrsim 1/3$, and it is concluded that thermal anisotropy cannot be invoked to explain the large azimuthal velocity of the solar wind. (2) Modification of the angular momentum balance of the solar wind by Alfvén waves by finite-wavelength (non-WKB) effects is considered. The Alfvén waves reduce v_ϕ at 1 AU by reducing the heliocentric distance of the critical point that appears in the equation for v_ϕ. This effect occurs because the waves act like a Reynold's "viscosity," but the sign is such that the viscosity is negative, leading to antirotation of the solar wind. This effect is only important for waves with $\omega^{-1} \gtrsim 10$ hours. (3) Finite-wavelength modifications of the wave pressure are considered. It is found that the wave pressure is reduced close to the Sun. This effect is important near 2 $R_\odot$ for waves with $\omega^{-1} \gtrsim 2$ hours. (auth)

8544 OBSERVATION AND ANALYSIS OF ABRUPT CHANGES IN THE INTERPLANETARY PLASMA VELOCITY AND MAGNETIC FIELD. Martin, R. N.; Belcher, J. W.; Lazarus, A. J. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res.; 78: No. 19, 3653-3662(1 Jul 1973).

A limited study is presented of the physical nature of abrupt changes in the interplanetary plasma velocity and magnetic field based on 19 days' data from the Pioneer 6 spacecraft. The period was chosen to include a high-velocity solar-wind stream and low-velocity wind. Abrupt events were accepted for study if the sum of the energy density in the magnetic field and velocity changes was above a specified minimum. A statistical analysis of the events in the high-velocity solar wind stream shows that Alfvenic changes predominate. This conclusion is independent of whether steady state requirements are imposed on conditions before and after the event. Alfvenic changes do not dominate in the lower-speed wind. This study extends the plasma field evidence for outwardly propagating Alfvenic changes to time scales as small as 1 min (scale lengths on the order of 20,000 km). (auth)

8545 SOLAR SPECKLE INTERFEROMETRY. Harvey, J. W.; Breckinridge, J. B. (Kitt Peak National Observatory, Tucson, AZ). Astrophys. J.; 182: No. 3, L137-L139(15 Jun 1973).

The technique of speckle interferometry was applied to solar photographs. Spatial frequencies as high as 4 cycles per arc second were detected in sunspots. (auth)

Galaxies

Refer also to abstracts 8508 and 8509.

8546 ABSORPTION AND PRODUCTION OF SOFT X-RAYS IN THE GALAXY. Hayakawa, S. (Nagoya Univ., Japan). Int. Astron. Union Symp.; No. 55, 235-249(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

The column densities of interstellar hydrogen to x-ray sources derived from their spectra are compared with those obtained from 21 cm radio observations. Referring to several observed results on Cyg X-2, Cygnus Loop, etc., the interpretation of the low energy cut-off of the spectrum in terms of the interstellar absorption is subject to ambiguities due to a modification of the emission spectrum by Compton scattering in the sources and the contribution of emission lines. The result of soft x-ray sky surveys indicates that the diffuse component of soft x rays consists of the extragalactic and the galactic components. The former has a hard component with a power law spectrum and a soft component which may be represented by an exponential spectrum. The galactic component is so soft that its spectrum may also be explained by thermal bremsstrahlung of temperature of about 0.1 keV. Its generation rate may account for the heating and ionization of interstellar matter. It is suggested that galactic diffuse soft x rays are produced by active stars of a rather high number density. (auth)

8547 STUDY OF IRREGULAR II GALAXIES. Krienke, O. K. Jr. Seattle, WA; Univ. of Washinton (1973). 155p. Microfilms Order No. 73-27,670.

Thesis (Ph. D.).

Eighteen possible members of the Hubble class Irregular II, including the Hubble–Sandage and Holmberg Irr. II galaxies, were examined for fit to the Hubble-Sandage Irr. II criteria. Common astrophysical properties beyond these criteria were sought. A subdivision into galaxies which are (1) dusty, but otherwise normal SOabc, (2) tidally interacting, and (3) explosive, shows fundamental coherence within sub-class. An extensive radial Hα filamentary structure unifies the explosive class of NGC's 3034 (the explosive prototype), 5253 (an emission elliptical), and 3077 (an early SO), and relates this subclass to the Seyfert galaxy NGC 1275. (WDM)

8548 INTEGRATED SPECTRAL ENERGY DISTRIBUTIONS OF GALAXIES. Wells, D. C. III. Austin, TX; Univ. of Texas (1973). 197p. University Microfilms Order No. 73-26,106.

Thesis (Ph. D.).

A computer-controlled scanning spectrophotometer attached either to the 82-inch or to the 107-inch telescope at McDonald Observatory was used to measure spectral energy distributions of the integrated light of eleven galaxies of various morphological types. The wavelength range of the measurements was 3500 Å to 5530 Å, and the full width at half-maximum of the instrumental profile was about 50 Å. Aperture ratios $A/D(O) \simeq 1$ were achieved. The energy distributions of ten of the galaxies were grouped into four morphological classes which are representative of the full range of galaxy types. The groups consisted of four galaxies of types E and SO, two spirals of types Sa and Sb, two spirals of type Sbc, and an Sdm spiral plus an irregular galaxy. Mean energy distributions were formed for each of the four groups, and K-corrections were computed for each group for the B and V magnitudes and for the B-V color. The corrections for the elliptical and lenticular galaxy group are in agreement with similar functions tabulated previously by Whitford and by Schild and Oke. The corrections for the other three groups are new results and will be useful for the estimation of corrections to general galaxy counts made to various limiting magnitudes. The spiral and irregular galaxies are shown to fade more slowly with increasing redshift than do the elliptical and lenticular galaxies. Therefore, the apparent relative proportions of various types of galaxies in the counts will vary as a function of limiting magnitude. (Diss. Abstr. Int., B)

8549 MASS DISTRIBUTION OF OBJECTS UNDERGOING COLLISIONS WITH APPLICATIONS TO INTERSTELLAR CLOUDS, STAR FORMATION IN GALACTIC CLUSTERS AND THE ASTEROID BELT. Taff, L. G. Rochester, NY; Univ. of Rochester (1973). 301p. Microfilms Order No. 73-25,857.

Thesis (Ph. D.).

A theoretical framework is presented in which one can discuss the mass spectra of interacting species. It is applied here to interstellar neutral hydrogen clouds, star formation in galactic clusters, and the asteroid belt. The theory predicts the number of objects of mass m per unit volume at time t, N(m,t). An equation for $\partial N(m,t)/\partial t$ is derived similar to the Boltzmann equation. Included in the kernel of the double integral, in addition to σv, is the central physical element of the theory, the conditional probability that once objects of mass m,m′ have collided they yield new objects of mass M, M′, . . . , M″. This quantity is symbolized by P(m, m′; M, M′, . . . , M″). (WDM)

8550 DISTRIBUTION OF RADIO INTENSITY OF GALAXY BACKGROUND IN DECAMETER-RANGE RADIO WAVES. Zhuk, I. N. (Inst. of Radiophysics and Electronics, Kharkov). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 754-758(1973). (In Russian).

Frequency spectra showed that in the cold region of the Galaxy and at the poles the cosmic radiation is in the 12.6- to 404-MHz range, which indicates the absence of marked absorption of decameter waves in these regions. In the direction of the galactic disk, the frequency spectrum deviated considerably from a linear dependence in the decameter range. Graphs are presented showing the relations between various pertinent indexes. (TTT)

8551 RADIO WAVE COSMIC BACKGROUND AT A FREQUENCY OF 10 MHz. Antonov, A. V. (Inst. of Radiophysics and Electronics, Kharkov). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 759-761(1973). (In Russian).

Studies of the subject waves showed that the spectral indexes at the north and south poles are the same and equal to 0.52. In the disk region, within −10° and +10° along "b", there is a sharp decrease in α with a minimum at the disk surface. Directly at the disk surface, in the direction from the anticenter to the center, the spectral index drops from 0.53 to 0.28. The absolute minimum in α is at the galactic center. The maximum α, 0.68, is in the region of a section along "b" at $l = 30°$. At $l = 180°$, $\alpha = 0.44$. (TTT)

8552 DISCOVERY OF HOT GAS IN THE COLLECTED GALAXY "VERONICA'S HAIR". Parfiskii, Yu. N. (Special Astrophysical Observatory, Leningrad). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 5, 784-785(1973). (In Russian).

Observations indicated the presence of a hot gas in the subject region, but quantitative measurements could not be made. The indicated electron temperature of 10^6 to 10^7°K suggests that the mass of ionized gas is less than "virial." (TTT)

Cosmology

Refer also to abstracts 8505 and 9292.

8553 EVOLUTIONARY THEORIES OF THE X-RAY BACKGROUND. Rees, M. J. (Harvard Coll. Observatory, Cambridge, MA). Int. Astron. Union Symp.; No. 55, 250-257(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

It is unclear whether evolutionary effects must be invoked to account for the intensity of the x-ray background, nor whether the background could all be due to unresolved x-ray sources of the types already known. Intensity fluctuations on small angular scales are probably on the threshold of detectability. Future studies of these fluctuations — with improved sensitivity — should help to elucidate the nature of the background. The interpretation of such studies is discussed. (auth)

8554 LOCAL THEORIES OF THE X-RAY BACKGROUND. Felten, J. E. (Univ. of Arizona, Tucson). Int. Astron. Union Symp.; No. 55, 258-275(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

Recent theories of the origins of diffuse-background x rays are reviewed, with emphasis on theories of the soft flux in the galactic plane and at the poles. This is probably partly galactic and partly extragalactic in origin. Failure to observe absorption by the Small Magellanic Cloud and by galactic gas in neighboring directions may be due to sources in the Cloud and to statistical fluctuations in galactic emission and absorption. Several models for numerous low-luminosity sources in the Galaxy are available. True "diffuse" emission seems unnecessary. Absorption by galactic gas seems to agree roughly with theory. The soft extragalactic component may arise in a hot intergalactic medium. The existence of a "diffuse" galactic-plane excess in 1 to 100 keV is in some doubt. Low-luminosity sources may contribute to this as well. For isotropic x-rays in 1 keV to 1 MeV, superposition theories involving clusters of galaxies, Seyfert galaxies,etc. over a cosmological path length are now roughly viable. Simple "metagalactic" Compton theories seem excluded if the break at 40 keV is sharp, but this is now in doubt. A very hot intergalactic medium at $T \approx 3 \times 10^8$ K would give the possibility of a sharp break. A recent upper limit on the line source strength of 100-MeV photons in the galactic plane may create some difficulties for cosmic-ray theory. The spectral shape of $\pi-\gamma$ photons has become a matter of theoretical dispute. (auth)

8555 DIFFUSE BACKGROUND OF ENERGETIC X RAYS. Pal, Y. (Tata Inst. of Fundamental Research, Bombay). Int. Astron. Union Symp.; No. 55, 279-302(1973).

From symposium X - and γ-ray astronomy; Madrid, Spain (11 May 1972). See CONF-720599-.

The experimental situation in regard to the extragalactic diffuse background of photons of energy above 30 keV is critically reviewed in the light of discussions at this Symposium. There seems to be some doubt about the spectral break at 40 keV. There is an indication of a small bump around 2 MeV and of a shoulder around 20 MeV. The spectrum below 1 MeV (down to 30 keV) can perhaps be represented as 25 $(E/1\ keV)^{-2.1}$. This spectrum also gives, roughly, the OSO III upper limit at 100 MeV, though it lies well below the two bumps mentioned above. A good deal of the discussion centers on the problem of backgrounds in different types of experiments to measure the diffuse x- and γ-ray fluxes. (auth)

8556 METRIC THEORIES OF GRAVITY AND THEIR ASTROPHYSICAL IMPLICATIONS. Ni, W. T. Pasadena, CA; California Inst. of Tech. (1972). 84p. Microfilms Order No. 73-26,475.

Thesis (Ph. D).

The increasing importance of relativistic gravity in astrophysics has led to the need for a detailed analysis of theories of gravity and their viability. Accordingly, in this thesis, metric theories of gravity are compiled, and are classified into four groups: (i) general relativity, (ii) scalar-tensor theories (iii) conformally flat theories, and (iv) stratified theories. The post-Newtonian limit of each theory is constructed and its Parametrized Post-Newtonian (PPN) values are obtained. These results, when combined with experimental data and with recent work by Nordtvedt and Will, show that, of all theories thus far examined by our group, the only currently viable ones are (i) general relativity, (ii) the Bergmann–Wagoner scalar-tensor theory and its special cases (Nordtvedt; Brans–Dicke–Jordan), (iii) recent, (as yet unpublished) vector–tensor theory by Nordtvedt, Hellings, and Will, and (iv) a new stratified theory by the author, which is presented for the first time in this thesis. The PPN formalism is used to analyze stellar stability in any metric theory of gravity. This analysis enables one to infer, for any given gravitation theory, the extent to which post-Newtonian effects induce instabilities in white dwarfs, in neutron stars, and in supermassive stars. It also reveals the extent to which the current empirical knowledge of post-Newtonian gravity (based on solar-system experiments) actually guarantees that relativistic instabilities exist. In particular, it shows that for "conservative theories of gravity," current solar-system experiments guarantee that relativistic corrections do induce dynamical instabilities in stars with adiabatic indices slightly greater than 4/3, while for "nonconservative theories," current experiments do not permit any firm conclusion. (Diss. Abstr. Int., B)

8557 C^∞-PERTURBATIONS OF A COSMOLOGICAL MODEL. White, P. C. (St. Edward's Univ., Austin, TX). J. Math. Phys. (N. Y.); 14: No. 7, 831-836(Jul 1973).

It is shown that the so-called "moment condition" imposed by R. K. Sachs and A. M. Wolfe in their general treatment of the perturbation problem for k = O Robertson–Walker universes both exclude physically reasonable solutions and are unnecessary. This restriction is removed by establishing that the Sachs–Wolfe solution gives the most general C^∞ solution provided the potentials are C^∞. (auth)

8558 RED-SHIFTS OF QUASI-STELLAR OBJECTS IN THE THEORY OF THE GENERALISED GRAVITATIONAL POTENTIAL. Cherry, N. H. Int. J. Theor. Phys.; 8: No. 1, 47-49(1973).

The analysis by Burbidge et al (Astrophys. J.; 170: 233 (1973)) on the proximity of quasi-stellar objects (QSOs) to bright galaxies is considered within the theory of the generalized gravitational potential. It is shown that in this theory the redshift data are consistent with a connection hypothesis for three of the four QSO–galaxy systems considered in the statistical analysis. (auth)

8559 ORIGIN OF THE UNIVERSE. The Presidential Address. Hoyle, F. (Cambridge Univ., Eng.). Quart. J. Roy. Astron. Soc.; 14: No. 3, 278-287(Sep 1973).

From anniversary meeting of the Royal Astronomical Society; London, Eng. (9 Feb 1973).

It is stated, in relation to the discovery of the expansion of the system of galaxies, that discussion of alternative cosmological models has been unproductive, as accumulated data have not been sufficient to distinguish with adequate accuracy between the various possibilities. The central problem is the meaning to be attached to the concept of an "origin" for the Universe. The so-called steady-state model is compared with a typical older cosmology. The implications of the discovery of the microwave background radiation are considered, in relation to the Einstein–de Sitter cosmology, and other possible models. It is suggested that it is necessary to add a part of the Universe beyond $\tau = 0$, and this approach is developed in some detail. The idea is introduced that $\tau = 0$ is the locus of special points on the paths of particles, and that it is from these special points that mass fields are generated. It is possible to calculate the situation for $\tau > 0$ without being concerned with the "outside" beyond $\tau = 0$. It is stated that in this respect the situation is reminiscent of Kirchoff's theorem in electrodynamics, where the effect of the "outside" on a closed volume V can be represented in terms of conditions at the boundary of V. Similarly, the structure ordinarily thought of as "the Universe" is part of a larger whole. Instead of electromagnetic fields, as in Kirchoff's case, there are the fields which control the particle masses. Because the fields are generated from the boundary, the particle masses must start there from zero, which is the property that has caused the boundary to be thought of hitherto as a singularity. The possibility of learning anything of the structure of such a Universe "outside" is briefly discussed. (UK)

8560 PROPERTIES OF FRIEDMONS AND THE EARLY STAGE OF THE EVOLUTION OF THE UNIVERSE. Man'ko, V. I.; Markov, M. A. (Lebedev Inst. of Physics, Moscow). Teor. Mat. Fiz.; 17: No. 2, 160-164(Nov 1973). (In Russian).

In the framework of the hot Universe model the estimates of the possible concentration of the friedmons (i.e., fundamental particles of the mass $10^{-4}-10^{-5}$ gr) at early stages of the evolution of the Universe are made out. It is shown that the density of matter at the moment of (tempering) the friedmons is of the order 10^{93} gr/cm^3. (auth)

8561 ELECTROMAGNETIC DETECTORS OF GRAVITATIONAL WAVES. Braginskii, V. B.; Grishchuk, L. P.; Doroshkevich, A. G.; Zel'dovich, Ya. B.; Novikov, I. D.; Sazhin, M. V.

(Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1729-1737(Nov 1973). (In Russian).

The detection of gravitational waves with electromagnetic resonators and waveguides is considered. The variation of the electromagnetic wave in resonators induced by gravitational waves passing through it is evaluated. Optimal methods of detecting gravitational waves are mentioned and the minimal gravitational wave fluxes which should be experimentally detectable are estimated. (auth)

Planetary Phenomena

Refer also to abstract 8527.

8562 DEPTH PROFILE OF ^{53}Mn IN THE LUNAR SURFACE. Imamura, M.; Finkel, R. C.; Wahlen, M. (Univ. of California, San Diego). Earth Planet. Sci. Lett.; 20: No. 1, 107-112(Sep 1973).

Measurements of cosmic-ray produced ^{53}Mn are reported for a series of lunar surface samples down to a depth of 416 g/cm^2. These results clearly illustrate the decrease in activity with depth as the incident galactic cosmic rays are absorbed. Below 60 g/cm^2 the production rate decreases exponentially with a mean length, λ, of about 220 g/cm^2. These results indicate that, at the Apollo 15 site, the lunar regolith has been unmixed, on a meter scale, for the last 5 my. The neutron activation technique for ^{53}Mn, which allowed samples smaller than 200 mg to be used for these measurements, is described. (auth)

8563 CHRONOLOGY OF THE TAURUS-LITTROW REGION. I. Ages of Two Major Rock Types from the Apollo 17-Site. Kirsten, T.; Horn, P.; Heymann, D. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Earth Planet. Sci. Lett.; 20: No. 1, 125-130(Sep 1973).

The ^{39}Ar/^{40}Ar gas retention age of the subfloor basalt 75055 is $(3.82 \pm 0.05) \times 10^9$ yr; its Ca/^{38}Ar exposure age is $(85 \pm 10) \times 10^6$ yr (Camelot crater age). The ages of the matrix material of greenish-grey breccia 76055 are $(4.05 \times 0.07) \times 10^9$ and $(120 \pm 15) \times 10^6$ yr, respectively. The gas retention age of 75055 raises the lower limit for the time of formation of all lunar basins. Of the breccia represents metamorphosed Serenitatis basin ejecta, then the formation of at least 28 lunar basins occurred between 3.82×10^9 and 4.05×10^9 yr ago. The formation of these basins during a timespan of only about 0.2×10^9 yr is consistent with the very rapid decrease of the flux of crater-forming projectiles that collided with the Moon about 4.0×10^9 yr ago. According to Hartman and Wood this could be due to a catastrophic event in the Earth-Moon system at that time. (auth)

8564 NIGHT SIDE ELECTROMAGNETIC RESPONSE OF THE MOON. Schubert, G. (Univ. of California, Los Angeles); Smith, B. F.; Sonett, C. P.; Colburn, D. S.; Schwartz, K. J. Geophys. Res.; 78: No. 19, 3688-3696(1 Jul 1973).

The electromagnetic response of the Moon to excitation by the time-dependent fluctuations of the interplanetary magnetic field is given for the dark or antisolar hemisphere of the Moon. Six hours of time series data from the Explorer 35 Ames magnetometer and the lunar surface magnetometer on Apollo 12 were used to obtain the Fourier spectral amplitudes of the surface and interplanetary fields from which transfer functions were calculated for the east-west, north-south, and vertical directions at the Apollo site in the bandwidth $1.7 \times 10^{-3} \leq f \leq 3 \times 10^{-2}$ Hz. The tangential magnetic field on the night side hemisphere is amplified by confinement within the diamagnetic cavity and redistribution of magnetic field lines from the sunlit to the night side. Vacuum scattering from even a perfectly conducting Moon cannot produce the observed night side tangential magnetic field amplification. The night side electromagnetic behavior of the Moon is not that of a body in vacuum. A critical discussion of lunar conductivity profiles derived from night side radial magnetic field data and vacuum scattering theory is presented. Limitations imposed by the quantity and the frequency range of the data and the necessity to account for contributions from cavity confinement and internal redistribution of field lines to the night side radial field make heretofore derived night side conductivity profiles unreliable. In particular, it is shown that there is no evidence for a lunar core as conducting as 10^{-2} mho/m. Inversion of night side radial magnetic field data should await the development of a time-dependent asymmetric theory of lunar magnetic induction. (auth)

8565 EXCESS LEAD IN RUSTY ROCK 66095 IMPLICATION FOR AN EARLY LUNAR DIFFERENTIATION. Nunes, P. D.; Tatsumoto, M. (Geological Survey, Denver). Science; 182: No. 4115, 916-919(30 Nov 1973).

Apollo 16 breccia 66095 contains a remarkably high amount of lead (15 parts per million), 85 percent of which is not supported by uranium and thorium in the rock. An acid leach experiment coupled with separate analyses of the whole rock and mineral fractions for uranium, thorium, and lead indicate that the excess lead has a lunar source and was apparently introduced about 4.0×10^9 years ago. The data also suggest that a major lunar crustal differentiation occurred about 4.47×10^9 years ago. (auth)

8566 EQUILIBRATION OF DEUTERIUM IN THE JOVIAN ATMOSPHERE. Beer, R.; Taylor, F. W. (Jet Propulsion Lab., Pasadena, CA). Astrophys. J.; 182: No. 3, L131-L132(15 Jun 1973).

Recent observations of deuterium in the Jovian atmosphere in the CH_3D and HD phases permit a reexamination of the mechanism of deuterium fractionation in Jupiter. It is shown that catalysis must play an important role in the reaction paths and that, most probably, the catalytic agents are embedded in the lower cloud deck. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstract 9134.

8567 (N-72-18327) EFFECT OF ESCAPING PHOTOELECTRONS IN A POLAR EXOSPHERIC MODEL. Lemaire, J. (Institut d'Aeronomie Spatiale de Belgique, Brussels). Jun 1971. 17p. NTIS.

The effect of a photoelectron escape flux on a polar wind model is discussed. It is shown that the additional electric drag force due to the escaping photoelectrons can accelerate the ions to higher velocities if the photoelectron flux is larger than the escape flux of the thermal electrons. Furthermore, it is shown that, even if the number density of the photoelectrons remains small compared to the number density of the thermal electrons, their kinetic pressure becomes important at very high altitudes. As a consequence a positive gradient in the electron temperature can be expected in the sunlit polar-cap upper region. (STAR)

8568 (N-73-21611) SIMULTANEOUS IN SITU ELECTRON TEMPERATURE COMPARISONS USING ALOUETTE 2 PROBE AND PLASMA RESONANCE DATA. Benson, R. F. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Feb 1973. 15p. (NASA-TM-X-66205). NTIS.

The electron temperatures deduced from Alouette 2 diffuse resonance observations are compared with the temperature obtained from the Alouette 2 cylindrical electrostatic probe experiment using data from 5 mid-to-high latitude telemetry stations. The probe temperature is consistently higher than the diffuse resonance temperature. The average difference ranged from approximately 10 to 40% with the lower values occurring at the lowest altitudes sampled (near 500 km) and at high latitudes (dip latitude greater than 55 deg), and the larger values occurring at high altitudes and lower latitudes. The discrepancy appears to be of geophysical origin since it is dependent on the location of the data sample. The present observations support the view that the often observed radar backscatter-probe electron temperature discrepancy is also of geophysical origin. (STAR)

8569 PHYSICS AND CHEMISTRY OF UPPER ATMOSPHERES. Proceedings of a Symposium Held at Orleans, France, July 31–August 11, 1972. McCormac, R. M. (ed.). Astrophysics and Space Science Library. Volume 35. Lawrence, MA; D. Reidel Publishing Company, Inc. (1973). 397p. (CONF-720721-). $42.50.

From chemistry and physics of upper atmospheres meeting; Orleans, France (31 Jul 1972).

This book contains the lectures presented at the Summer Advanced Study Institute, "Physics and Chemistry of Upper Atmospheres" which was held at the Univ. of Orleans, during the period July 31 through Aug. 11, 1972. Lectures covered the topics: structure and composition of the atmosphere; physical processes; chemical processes and models; experimental results and interpretations; and other planets. (WDM)

8570 ELECTRON CONTENT OF THE AURORAL IONOSPHERE DURING RADIO ABSORPTION EVENTS. Hargreaves, J. K. (Univ. of Lancaster, Eng.); Lyon, G. F. Radio Sci.; 8: No. 12, 1111-1117(Dec 1973).

The relations between electron content, scintillation, and radio absorption were studied at an auroral zone station. It was found that during absorption events, indicating particle precipitation, the level of scintillation increases and the electron content increases in winter but is unchanged or slightly decreased in summer. At a given level of scintillation, the absorption was greater on a winter day than on a summer day. Although some of the observations were consistent with the results of other investigations, full explanations are lacking. It seems clear that, in addition to direct ionization production by auroral particles, other mechanisms must be involved. Further studies based on reception of geostationary satellite transmissions are recommended. (auth)

8571 SPIN MODULATION OF HIGH-LATITUDE HISS MEASURED BY AN ELECTRIC DIPOLE. James, H. G. (Communications Research Centre, Ottawa). Radio Sci.; 8: No. 12, 1133-1147 (Dec 1973).

Natural radio noise received by the ISIS satellites in the polar and auroral regions often exhibits spin modulation. For noise in the whistler-mode frequency domain observed on seven high-latitude passes, the data indicate that temporal-spatial variations in the level of the noise source are not important on a time scale of one spin period, and thus the dependence of the signal on the attitude of the receiving dipole antenna can be studied. Relative variations in level during one half of a spin period were synthesized by simply convolving the attitude dependence of the antenna impedance with a spatial distribution of electric vectors. The resonance cone angle, corresponding to the infinity in the refractive index, was predicted to an accuracy of 3°, while the theoretical amplitude and shape of the modulation agreed well with what was observed. It was found that longitudinal electric waves yield better agreement than transverse electromagnetic waves. In some cases, preferred horizontal propagation directions could be roughly identified. The computations confirmed the relevance of establishment theory for the antenna impedance and the ion sheath. (auth)

8572 STRUCTURE AND FLUCTUATIONS OF THE OH AIRGLOW AT 1.65 AND 2.15 μ. Kieffaber, L. M. Albuquerque, NM; Univ. of New Mexico (1973). 244p. Microfilms Order No. 73-27,768.

Thesis (Ph. D.).

The structure and fluctuations of the infrared airglow were studied at 1.65 and 2.15 μ. The emission at 1.65 μ is due to the (5,3) and (6,4) rotation-vibration bands of the OH molecule, and the 2.15 μ emission is due to the (9,7) OH band. Observations were made at Capilla Peak Observatory, New Mexico, and Haleakala Observatory, Hawaii, using two scanning photometers, of apertures 12 and 24 inches, equipped with interference filters and lead sulfide cells as detectors. The photometers have fields of view of the order of one degree, permitting the resolution of very small-scale spatial structure. Half-sky and all-sky maps reveal striations and cellular structures at both wavelengths. Small patches of bright and faint emission, of angular dimension 2 to 15° are seen in addition to very large slowly moving "intensity clouds" that cover significant fractions of the sky. At 1.65 μ the r.m.s. spatial fluctuations along almucantars range from 19 to 0.9%, decreasing with elevation angle, with an average value of 7.5%. At 2.15 μ the r.m.s. spatial fluctuation ranges from 12 to 0.6% along almucantars, with an average over elevation of 2.5%. The 1.65 μ spatial fluctuations are approximately twice as big as those at 2.15 μ and the evening fluctuations are found to be more pronounced than in the mornings. It was discovered that the submicron infrared airglow could be photographed to reveal its continually changing structure. The 1.65 and 2.15 μ emissions are found to be strongly correlated with an average correlation coefficient of 0.85 implying either a single mechanism for the excitation of the (9,7), (5,3), and (4,2) OH bands or an initial excitation to the v = 9 vibrational level followed by cascading. The measurements of absolute zenithal intensity of the infrared airglow during this study resulted in values of $(1.9 \pm 0.6) \times 10^{-6}$ w/(cm^2 ster μ) at 1.65 μ and $(1.3 \pm 0.2) \times 10^{-6}$ w/(cm^2 ster μ) at 2.15 μ. (Diss. Abstr. Int., B)

8573 ELECTRON DENSITY PROFILES IN THE LOWER IONOSPHERE DEDUCED FROM LONG PATH vlf WAVE PROPAGATION. Rinnert, K. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). Radio Sci.; 8: No. 10, 829-836(Oct 1973).

Based on waveguide mode theory and a simple model to calculate the ionospheric reflection coefficient, electron density profiles were deduced from vlf data. A simplified day/night transition model is described. It is appropriate for explaining the mode conversion during sunset and sunrise and leads to conclusions concerning the change of the electron density profile within the transition region. (auth)

8574 METHOD FOR PREDICTING THE F_1 LAYER CRITICAL FREQUENCY BASED ON THE ZURICH SMOOTHED SUNSPOT NUMBER. DuCharme, E. D. (Communications Research Centre, Ottawa); Petrie, L. E.; Eyfrig, R. Radio Sci.; 8: No. 10, 837-839 (Oct 1973).

A series of expressions to calculate the monthly median F_1 layer penetration frequency (foF_1) as a function of the ionospheric index IF_2 was reported by DuCharme et al., [1971]. Using similar techniques and the same data base, development of a series of expressions to calculate foF_1 as a function of the Zurich smoothed sunspot number R_{12} is described. The derived expressions are evaluated for the period of maximum solar activity 1967 through 1969 and compared with observed foF_1 data for this period, which are outside the 1954 through 1966 data base used to develop the expressions. (auth)

8575 ENERGETIC PARTICLES DURING THE SOLAR PARTICLE EVENT OF NOVEMBER 2, 1969. Oliver, G. J. Chapel Hill, NC; Univ. of North Carolina (1973). 124p. Microfilms Order No. 73-26,221.

Thesis (Ph. D.).

Investigations of particle fluxes were made in the altitude range from 40 to 120 kilometers, using the Nike Javelin. On board the rocket were detector systems with a three-detector telescope assembly that was capable of detecting electron, proton, alpha and electromagnetic fluxes and one that contained a silicon avalanche detector designed to detect low energy electrons. Extensive studies of low energy electron spectra are made using information from both detector systems and certain references (Chandler, 1972; Atwell, 1972; Lanzerotti, 1971; Regan, 1971). The radiological hazard due to the alpha, proton, and electron fluxes is evaluated as a function of depth in tissue. The continuous energy distributions for the particulate radiations complicate the calculation of dose. The rate of energy loss is continuously changing as particles penetrate tissue. Electrons undergo significant scattering that changes the depths at which energy is absorbed. These are a few of the problems solved in evaluating the dose as a function of depth in soft tissue. Extensive use of computers is required to reduce the particle flux data. Several programs have been written to analyze the rocket data and facilitate the hazard evaluation. (Diss. Abstr. Int., B)

8576 SIMPLE MODEL OF THE VERTICAL DISTRIBUTION OF ELECTRON CONCENTRATION IN THE IONOSPHERE. Bradley, P. A.; Dudeney, J. R. (Science Research Council, Slough, Eng.). J. Atmos. Terrest. Phys.; 35: No. 12, 2131-2146(Dec 1973).

An idealized model of the vertical distribution of the electron concentration in the E and F regions of the ionosphere is developed in which the model parameters are given by simple empirical expressions in terms of the characteristics conventionally measured at ionospheric observatories. Differences in the heights with a given electron concentration, as indicated by the model and by true-height profile analyses, are usually 20 km or less. (auth)

8577 D-REGION PARAMETERS AT HIGH LATITUDES OBTAINED FROM ROCKET EXPERIMENTS. Derblom, H.; Ladell, L. (Foersvarets Forskningstalt, Uppsala). J. Atmos. Terrest. Phys.; 35: No. 12, 2123-2130(Dec 1973).

Two experiments during auroral conditions at nighttime and one experiment in twilight during quiet conditions are discussed. Electron- and ion-density profiles are given, as well as the height variation of the negative-ion to electron ratio and the effective electron loss coefficient. The ion density was found to increase again below ≈ 80 km in all three experiments. This increase seems to be correlated with the presence of heavy clustered ions. (auth)

8578 HIGH LATITUDE ELECTRON AND PROTON PRECIPITATION AT DIFFERENT LOCAL TIMES AND MAGNETIC ACTIVITY. Wedde, T.; Skovli, G.; Amundsen, R.; Aarsnes, K.; Lindlen, H. R.; Soraas, F. (Forsvarets Forshninsestitalt, Kjeller, Norway). J. Atmos. Terrest. Phys.; 35: No. 12, 2191-2203(Dec 1973).

Data are presented from simultaneous polar orbiting ESRO-IA (Aurorae) satellite measurements of electron and proton precipitation at high latitudes. The data are sampled in different local time sectors and at different geomagnetic activity levels for Kp ≤ 4-, permitting a presentation of some characteristic features and modes of behavior of electron and proton precipitation during different conditions. The latitudinal position and displacement of the precipitation zones vs. local time and geomagnetic activity are described as well as the mutual relations regarding flux magnitudes of the two particle species. The flux profiles from individual passes have been compared with median flux profiles of electrons and protons pertinent to quiet and disturbed geomagnetic conditions. The energy ranges studied are for protons between 115 and 180 keV and for electrons greater than 40 keV. (auth)

8579 SEASONAL BEHAVIOR OF THE F2-LAYER OF THE IONOSPHERE. Torr, M. R.; Torr, D. G. (Council for Scientific and Industrial Research, Pretoria). J. Atmos. Terrest. Phys.; 35: No. 12, 2237-2251(Dec 1973).

The global distribution of variations in the behavior of the electron density of the F2-layer at midday is examined for different levels of solar activity. It is found that the variations in Nmax can be divided into three major components: winter maximum (seasonal), equinoctial maxima (semi-annual) and a component which peaks in December–January (annual). At solar maximum, the winter maximum prevails over much of the northern hemisphere and appears to be due to an increase in the $[O]/[N_2]$ ratio caused by convection of the O from the summer to winter hemisphere. The winter maximum also occurs in the Australian-Indian Ocean section of the southern hemisphere. The equinoctial maxima prevail over the remainder of the globe. It is suggested that this is due to the semi-annual variations in neutral densities associated with geomagnetic and auroral activity. In the South Pacific–South Atlantic regions summer noon peak electron densities are greater than those in winter. It is suggested that this is due to particle precipitation in these regions which surround the geomagnetic anomaly. As solar activity declines, the extent of the winter maximum decreases and only that in the northern hemisphere in the longitudes of the magnetic anomaly remains. The evidence points to an energy input imbalance between northern and southern hemispheres which can be attributed to the lower magnetic intensities which prevail over a large area of the southern hemisphere. As a result meridional convection from the southern summer to the northern winter regions is enhanced in these longitudes, and the reverse flow from the northern summer to southern winter is decreased so that the equinoctial or summer maximum predominates. The semi-annual component decreases with solar activity and the summer maximum regions become more predominant. (auth)

8580 ANALYSIS OF THE SOLAR-ACTIVITY EFFECTS IN THE UPPER ATMOSPHERE. Jacchia, L. G.; Slowley, J. W.; Campbell, I. G. (Smithsonian Astrophysical Observatory, Cambridge, MA). Planet. Space Sci.; 21: No. 11, 1835-1842(Nov 1973).

A study of the upper-atmosphere variations induced by solar activity was made by using 29,574 densities derived from the drag of 10 satellites in the interval 1958 to 1971. In a comparison of the respective merits of the Ca II-plage index and the 10.7 cm solar flux to represent the erratic ("27 day") component of the variation, the latter is shown to give invariably better results. The ratio $\Delta T/\Delta F$ of the temperature variations to the variations of the decimetric flux is shown to vary considerably with solar activity, but little with height or with local solar time. The time lag of the atmospheric variations behind those of the decimetric flux varies from a minimum of 0.9 day at noon to 1.6 days at midnight. (auth)

8581 STUDY OF THE DIURNAL VARIATION IN THE THERMOSPHERE AS DERIVED BY SATELLITE DRAG. Jacchia, L. G.; Campbell, A. G.; Slowey, J. W. (Smithsonian Astrophysical Observatory, Cambridge, MA). Planet. Space Sci.; 21: No. 11, 1825-1834(Nov 1973).

An analysis was performed on 29,574 densities derived from the drag of 10 satellites to determine simultaneously the parameters of the solaractivity effect in the thermosphere on the one hand, and the amplitude and shape of the diurnal-variation curve on the other. Only the study of the diurnal variation is reported here. Although a considerable amount of smoothing is inherent in the drag method, it seemed useful to see whether any change could be detected in the shape of the diurnal-variation curve with height, latitude, and solar activity. None was detected: the curve remains remarkably stable, symmetric, with a maximum at 14 hr 20 min L.S.T. and a minimum at 2 hr 20 min L.S.T. A systematic variation of the temperature range with height is observed when static models are used to derive it. (auth)

8582 DETERMINATION OF THE MINIMUM GROUP DELAY OF A NON-NOSE WHISTLER. Rycroft, M. J.; Mathur, A. (Southampton Univ., Eng.). J. Atmos. Terrest. Phys.; 35: No. 12, 2177-2182(Dec 1973).

A method of successive approximation is developed for the determination of the time of occurrence of a whistler's causative atmospheric, and hence the propagation time from one hemisphere to the other, t. The analysis is based on taking a range of possible t values and selecting that one which minimizes the standard error of the gradient of the best fit straight line between $Q(f) = 1/t\sqrt{f}$, the quantity introduced by Dowden and Allcock (J. Atmos. Terr. Phys.; 33: 1125 (1971)), and whistler frequency f. The method is thoroughly tested by applying it to nose-whistlers having a known causative sferic. It can be applied to whistlers either with or without a nose-frequency. Parameters such as the group propagation time per hop, the nose-frequency and minimum group delay (nose-time delay) are obtained to high accuracy, enabling the electron density in the equatorial plane of the magnetosphere and electron tube content to be estimated accurately at different L values. (auth)

8583 HIGH TEMPORAL AND SPATIAL RESOLUTION OBSERVATIONS OF LOW-ENERGY ELECTRONS BY A MOTHER-DAUGHTER ROCKET IN THE VICINITY OF TWO QUIESCENT AURORAL ARCS. Maehlum, B. N.; Moestue, H. (Norwegian Defence Research Establishment, Kjeller, Norway). Planet. Space Sci.; 21: No. 11, 1957-1967(Nov 1973).

Low-energy precipitated electrons have been measured with high-time resolution through an auroral display by a series of high geometrical factor particle counters on a "mother-daughter" sounding rocket, launched during wintertime near 2100 LT from Andenes, Norway. The observations show that the 0.5 to 3 keV electron fluxes are anisotropically distributed, with a maximum in a direction parallel to the local geomagnetic field vector at all latitudes covered by the rocket, except within the visual auroral forms where the pitch-angle distributions are isotropic or slightly

peaked in a direction normal to the geomagnetic field. The 1 and 3 keV electron fluxes are weakly anticorrelated in the vicinity of the arcs, where also the 3 keV electron flux displays a more structured variation than the 0.5 and 1 keV electron fluxes. (auth)

8584 LAMB WAVES GENERATED BY THE 1970 SOLAR ECLIPSE. Chimonas, G. (Univ. of Colorado, Boulder). Planet. Space Sci.; 21: No. 11, 1843-1854(Nov 1973).

The Lamb waves excited by an eclipse induced cooling of a cloud bearing tropospheric region are invoked to explain an experimental result obtained in the 7 March 1970 solar eclipse. Quantitative investigations are severely handicapped by the lack of data concerning the cooling rates throughout the region, but show that if this cooling rate is of the order of magnitude of the "lost" insolation the Lamb waves will explain the observed ground level pressure fluctuations. (auth)

8585 ELECTRON DISTRIBUTION AND NON-LINEAR WAVE PROPAGATION IN WEAKLY IONIZED PLASMAS WITH INELASTIC COLLISIONS. Jayaram, S.; Arora, A. K.; Buti, B. (Indian Inst. of Tech., Delhi). Int. J. Electron.; 35: No. 6, 825-832(Dec 1973).

An expression for the isotropic electron distribution function, f_0, for a slightly ionized homogeneous plasma subjected to a microwave field is obtained by means of the Boltzmann equation. Inelastic collisions are included, assuming that the average kinetic energy of the electrons is very much greater than the internal energy difference of the molecules for allowed transitions. Expressions for the current density and induced field in a nonlinear medium are also obtained. The theory outlined is applied to the study of the phenomena of demodulation of an amplitude-modulated wave. In the D region of the ionosphere, these inelastic effects contribute negligibly to the current density and the conductivity. (auth)

8586 DEPENDENCE OF FADING FREQUENCY ON THE CHARACTERISTICS OF IONOSPHERIC IRREGULARITIES. Sastri, J. H.; Rao, B. R. (Andhra Univ., Waltair, India). Indian J. Radio Space Phys.; 2: No.1, 88-90(Mar 1973).

A study was made of the relationship between fading frequency and the parameters that describe the nature and movement of ionospheric irregularities responsible for fading. It is noticed that the fading frequency is directly correlated with true drift speed and random velocity, and inversely with the structure size. (auth)

8587 ENHANCEMENT OF IONIZING RADIATION DURING A SOLAR FLARE FROM IONOSPHERIC DATA. Joseph, J. (Indian Inst. of Astrophysics, Kodaikanal). Indian J. Radio Space Phys.; 2: No. 1, 42-46(Mar 1973).

A theoretical approach is adopted to find out the energy increase in ionizing radiation during a flare from the available ionospheric data. The total ion production rate is equated with individual ion production rates due to four prominent spectral bands in the extreme ultraviolet and x-ray regions. Such equations, containing four unknowns corresponding to the photon fluxes, are formed for 17 heights in the range 150 to 230 km. The equations are solved for photon flux value for normal days and at the time of flare. (auth)

8588 ELECTRON CONTENT MEASUREMENTS DURING MAGNETIC STORMS AT KURUKSHETRA. Reddy, B. M. (National Physical Lab., New Delhi); Lakshmi, D. R.; Prakash, S.; Lal, J. B. Indian J. Radio Space Phys.; 2: No. 1, 26-29(Mar 1973).

Total electron content (N_t) measurements obtained by recording the beacon transmissions from Explorer-22 satellite at the University of Kurukshetra (29.9°N, 76.8°E) are reported for some magnetically active periods. The N_t values, along with f0F2 values from a nearby ionosonde, are compared with the magnetic activity. A novel feature of these results is that N_t shows varying degrees of enhancement, and depression of N_t below normal is not observed during any phase of the storm. The results also indicate that the response time of the ionosphere for sudden-commencement-type storms is shorter than that for gradual type storms. (auth)

8589 MOVEMENT OF SPORADIC-E AURORAL ZONE BETWEEN IGY AND IQSY. Saksena, R. C. (National Physical Lab., New Delhi). Indian J. Radio Space Phys.; 2: No. 1, 30-32(Mar 1973).

An analysis is done of the occurrence of sporadic-E at a few high latitude stations on quiet and disturbed days during the IGY and IQSY. At the upper boundary of the auroral zone the stations show a negative correlation with magnetic activity in IGY and positive correlation in IQSY, whereas stations on the lower boundary of the auroral zone show an opposite effect. This indicates possible movement, towards the pole, of the sporadic-E auroral zone from IGY and IQSY. (auth)

8590 TIME OF OCCURRENCE OF MAXIMUM IN LOW LATITUDE HORIZONTAL INTENSITY AND ITS DEPENDENCE ON MAGNETIC ACTIVITY. Arora, B. R.; Rangarajan, G. K. (Indian Inst. of Geomagnetism, Bombay). Indian J. Radio Space Phys.; 2: No. 1, 38-41(Mar 1973).

A study of the effect of increasing level of disturbance on the maximum of daily variation in H at two low latitude stations shows that with increasing magnetic activity, the time of maximum in daily variation in H shifts systematically to an earlier part of the day. It is suggested that this shift occurs due to the superposition of the asymmetric ring-current field on the field of dynamo origin. (auth)

8591 E-REGION ELECTRON TEMPERATURE MEASUREMENTS: A REVIEW. Mahajan, K. K. (National Physical Lab., New Delhi). Indian J. Radio Space Phys.; 2: No. 1, 1-21(Mar 1973).

The two major techniques for the E-region electron temperature measurements, namely, the Langmuir probe flown on rockets and the ground based incoherent-scatter radar, are discussed and results of the available measurements presented. While the radar measurements show the electron temperature to be very nearly equal to the neutral temperature at heights below 130 km, the Langmuir probes, in general, show electrons to be much hotter than neutrals for these heights. The radar measurements, however, are in agreement with theoretical studies of thermal balance in the E-region with euv as the only heat source. The Langmuir probe measurements, on the other hand, can only be explained if heat sources, in addition to the solar euv radiation, also exist. The surface contamination on Langmuir probe, coupled with low plasma density, can produce work function drift and consequently distort the current-voltage characteristic, resulting in erroneous electron temperature values in the E-region. (auth)

8592 SOME ANOMALOUS FEATURES OF THE IONOSPHERIC F2-LAYER AT LOW LATITUDE CONJUGATE PLACES. Parikh, N. K.; Kotadia, K. M. (Gujarat Univ., Ahmedabad, India). Indian J. Radio Space Phys.; 2: No. 1, 22-25(Mar 1973).

The diurnal variation of the F2-layer critical frequency (f0F2) is compared with the diurnal variations of the horizontal component H of the Earth's magnetic field and of the declination D at a pair of low latitude conjugate stations in the Pacific and the Atlantic zones for a medium-low solar activity period. It is shown that the daytime bite-out in f0F2 and its seasonal anomaly are dependent on the characteristic daily variation of the H-field. There is also an indication of the effect of E–W declination on the diurnal variation of f0F2 at places near magnetic dip 45 to 50° as explained by H. Kohl, J. W. King and D. Eccles [J. Atmos. Terr. Phys., 31(1969), 1011]; such effect is not observed at low latitudes. The day-time depression in f0F2 seems to be more pronounced at Port Stanley in summer than at its northern conjugate Puerto Rico, perhaps because of the additional effect of the neutral wind-associated vertical drift of ionization, for which the situation of Port Stanley (mean magnetic dip = 46.3°) is very favorable. (auth)

8593 PREDICTED ACOUSTIC GRAVITY WAVE ENHANCEMENT DURING THE SOLAR ECLIPSE OF JUNE 30, 1973. Frost, A. D.; Clark, R. R. (Univ. of New Hampshire, Durham). J. Geophys. Res.; 78: No. 19, 3995-3997(1 Jul 1973).

It is concluded that Faraday rotation observations using a synchronous satellite at 10 to 15°W may exceed those obtained on the Stanford-ATS1 link by a factor of 10 or more and that this unique enhancement may serve to identify those ionospheric irregularities due to the eclipse from a background of random and unrelated events. (WDM)

Magnetospheric Phenomena

8594 (TRITA-EPP-73-15) IONOSPHERE–MAGNETOSPHERE COUPLING. Bostroem, R. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Sep 1973. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

A review is given of some aspects of the electric coupling between the ionosphere and magnetosphere. Topics discussed are the mapping of time-dependent electric fields, the effects of Birkeland currents on the magnetospheric plasma convection, the relation of Birkeland currents to ionospheric electric field structures such as field reversals, secondary Birkeland currents of ionospheric origin and triggering of auroral particle precipitation, double-layers causing voltage drops along the magnetic field lines, and an equivalent electric circuit for the substorm currents in the coupled ionosphere–magnetosphere system. (SW)

8595 MODEL EXPERIMENT ON SOLAR FLARES AND THE NEUTRAL SHEET. III. Ohyabu, N.; Kawashima, N.; Okamura, S.; Yokota, T. (Hiroshima Univ.). Tokyo Daigaku Uchu Koku Kenkyusho Hokoku; 9: No. 2, 488-495(May 1973). (In Japanese).

A model experiment is performed on solar-flare phenomena and the magnetic neutral point behind the Earth. Anomalous resistivity

is observed in a collision-free magnetic neutral point discharge. It appears as a sharp rise (hump) of the voltage between discharge electrodes. This hump appears earlier and its height increases as (i) the plasma density is decreased, (ii) the discharge voltage is increased, and (iii) the external quadrupole magnetic field is increased. The electron temperature is measured from the absorption method of x-ray and the ion temperature from the Doppler broadening of HeII λ 4686. At the time of the appearance of this hump, the electron and ion temperatures rise abruptly up to 10 keV and 100 eV, respectively. This means that the magnetic energy which is supplied from the electric energy in the capacity is dissipated and converted into the thermal energy of the plasma. (auth)

8596 SOLAR CYCLE INFLUENCE ON THE LUNAR MAGNETIC VARIATION AT ISTANBUL. Isikara, A. M. (Univ. of Istanbul). Planet. Space Sci.; 21: No. 11, 1923-1930(Nov 1973).

The dependence of the amplitude of the lunar daily geomagnetic variation on sunspot number and magnetic activity is investigated using data from Istanbul for the years 1952 to 1968. Annual and seasonal values of the amplitudes of the lunar semi-diurnal variation are determined, and compared with sunspot number and magnetic activity using partial correlation techniques. (auth)

8597 PARTICLE MOTION AND CURRENTS IN THE NEUTRAL SHEET OF THE MAGNETOSPHERIC TAIL. Pudovkin, M. I.; Tsyganenko, N. A. (Leningrad State Univ.). Planet. Space Sci.; 21: No. 11, 2027-2037(Nov 1973).

The trajectories of plasma-sheet protons are computed numerically in magnetic-field models which simulate the neutral-sheet-type configuration observed in experiments. No electric field is included, in contrast with the reconnection theory. Entering the neutral sheet and then exiting from it, the particle performs an ordered displacement across the tail. A continuous interchange between the neutral and plasma sheets will give rise to an electric current which may be responsible for the observed magnetic-field configuration. An estimate of this current is made from the tension balance requirement, showing that a substantial anisotropy of the plasma-sheet pressure is necessary to maintain the steady state. It is shown that the neutral sheet itself can be a source of such an anisotropy, due to the nonadiabatic behavior of protons. Other anisotropy origins are discussed briefly. (auth)

8598 ELECTRON COUNTS IN THE NEUTRAL SHEET AND MAGNETIC VARIATIONS AT A GEOMAGNETIC LONGITUDE ASSOCIATED GROUND STATION. Bond, F. R.; Silzberger, P. H.; Thelander, H. A. Planet. Space Sci.; 21: No. 11, 2013-2025(Nov 1973).

A comparison of the variations in the count of electrons E > 36 keV on the satellite Vela 4A, and in the Macquarie Island magnetometer H trace, shows for a time lag of 22.8 min a correlation, r = 0.95, over a 90 min period of the recovery phase of a magnetospheric substorm on 17 August 1968. All-sky camera data suggest that during the correlation period the auroral electrojet showed very little latitudinal movement. Each peak in electron count relates to a current surge in the electrojet as shown by a deepening of the negative bay at Macquarie Island. Using the Fairfield (J. Geophys. Res.; 73: 7329 (1968)) model of the location of auroral shells in the solar magnetic equatorial plane, and the known location of the satellite, an estimate of the velocity of tail to Earth plasma convection in the plasma sheet of about 0.33 R_e/min is obtained for the recovery phase. The relationship is discussed between plasma sheet thinning and subsequent broadening, and the extension of the magnetic field lines into the tail region and their subsequent return. This discussion makes use of the estimated time lags between electron count at the satellite and the time of arrival of auroral particles at the antisolar meridian. From a somewhat speculative explanation, but one largely supported from the literature, of the magnetospheric processes involved in this auroral substorm, a plasma velocity estimate of 0.42 R_e/min for the initial phase of the substorm is obtained. These velocities are of the same order as the 0.5 R_e/min obtained by Lezniak and Winkler (J. Geophys. Res.; 75: 7075 (1970)) at 6.6 R_e. (auth)

8599 LATITUDINAL AND SEASONAL VARIATION OF THE WOLF RATIO M. Scheepers, G. L. M. (Council for Scientific and Industrial Research, Hermanus, S. Afr.). J. Atmos. Terrest. Phys.; 35: No. 12, 2183-2189(Dec 1973).

The sunspot cycle influence on the solar diurnal geomagnetic variation S, as measured by the Wolf ratio M, varies in a complicated way with latitude and season. Some of the characteristics of M can be explained qualitatively in terms of the generally accepted atmospheric dynamo theory. It is found that the S range has an annual as well as a semi-annual modulation. The semi-annual variation is not directly associated with the well known increase in magnetic activity that occurs during the equinoctial months, and cannot be explained in a simple way in terms of the S current system. It appears as if the amplitude of the semi-annual variation increases more rapidly with solar activity than the amplitude of the annual variation. In order to obtain more information on the semi-annual modulation of the diurnal range and thus on the latitudinal and seasonal dependence of M, attention should be paid to phase changes in S with changing solar activity. (auth)

8600 SEARCH FOR PERIODIC VARIATIONS IN GEOMAGNETIC ACTIVITY AND THEIR SOLAR CYCLE DEPENDENCE. Hauska, H.; Abdel-Wahab, S.; Dyring, E. (Uppsala Univ.). Phys. Scr.; 7: No. 3, 135-140(1973).

Periodic variations in geomagnetic activity were investigated, in the range from 4 to 40 days, by means of power spectrum analysis during the period 1932 to 1969. Main periodicities were found to exist at periods of 28.7, 13.3, 9.1 and 6.9 days. To investigate the influence of recurrent magnetic storms on the periodic phenomena in the data, in particular the 27-day variation, an attempt was made to remove disturbed periods from the data. The variation of the power density at different frequencies—particularly the 27-, 13-, 9-, and 6-day variation—with the solar cycle was investigated. An average value of the period of the 27-day variation was determined by means of a modified power spectrum technique. A high correlation with the solar cycle was found and possibilities of a multiple cycle are discussed. (auth)

8601 DETAILED STUDY OF THE GEOMAGNETIC STORM OF MARCH 8–10, 1970. Balakrishnan, T. K.; Varadarajan, R.; Baghavath Singh, S.; Karunakaran, D.; Aleem, P. S. M. (Indian Inst. of Astrophysics, Kodaikanal). Indian J. Radio Space Phys.; 2: No. 1, 65-71(Mar 1973).

A comprehensive study of the geomagnetic oscillations during the storm of March 8–10, 1970 is made, using data obtained from equatorial stations. The oscillation characteristics during the three main phases of the storm were computed from detailed spectral analysis of close-spaced horizontal force data. Simultaneity or otherwise of the various modes of oscillations were ascertained by coherence analysis of records of different pairs of stations. The results are discussed in the light of various observational results and magnetospheric models postulated thereon. (auth)

8602 BOW SHOCK AND ITS INTERACTION WITH INTERPLANETARY SHOCKS. Dryer, M. (National Oceanic and Atmospheric Administration, Boulder, CO). Radio Sci.; 8: No. 11, 893-901(Nov 1973).

Harbingers of significant magentospheric motions consist of the interactions of interplanetary discontinuities with the standing bow shock. The most common discontinuity is the tangential discontinuity. Less frequent in occurrence, but of major significance to subsequent magnetospheric dynamics, is the flare-generated interplanetary shock wave and its initiation of bow shock and magnetopause motion toward Earth. Early studies utilized the ordinary gas-dynamic analogy of the well-known Riemann splitting of an initial discontinuity (i.e., bow shock) into a reflected shock (the moving bow shock) and the transmitted shock (the inward-moving interplanetary shock). It was shown that order-of-magnitude pressure increases at the subsolar point of the magnetopause are readily found for typical shock-on-shock studies. Phenomenological studies also demonstrated, in agreement with observations, that the magnetopause motion could be predicted on the basis of quasi-static variation of the solar wind dynamic pressure. Recent hydromagnetic studies (for the simplified case of perpendicular shocks) have extended the theory to predict bow shock and magnetopause velocities which appear to be observed by spacecraft. Such one-dimensional studies provide upper limits for all average plasma parameters within the region of the Sun–Earth axis. The general case of the time-dependent interaction in three dimensions has, as yet, not been done. Nevertheless, the general configurational and plasma details are, in principle, amenable to examination with the use of multiple spacecraft measurements during the interaction and the ensuing dynamic motions on a time scale of tens of min to the several hr required for the magnetopause to move to smaller geocentric distances. The physical processes of various energy transfers from kinetic to thermal and magnetic as predicted by the hydromagnetic theory could then be assessed by study of the plasma average velocity, direction of flow, magnetic field, temperature, and density. The magnetosheath plasma properties following such interactions could, on a more speculative note, provide new boundary conditions (associated with appropriate magnetosheath and magnetosphere magnetic field polarities) which could, in turn, initiate and drive the reconnection process within the magnetopause. (auth)

8603 QUALITATIVE STUDY OF THE RECONNECTION BETWEEN THE EARTH'S MAGNETIC FIELD AND AN INTERPLANETARY FIELD OF ARBITRARY ORIENTATION. Cowley,

S. W. H. (Univ. of Colorado, Boulder). Radio Sci.; 8: No. 11, 903-913(Nov 1973).

To the present date only the reconnection process for exactly antiparallel fields has been discussed in detail. In magnetospheric terms this restricts us to the consideration only of southward interplanetary fields. The qualitative study presented shows how reconnection takes place between arbitrarily oriented fields in infinite and finite geometries. The process may best be thought of as a continuous exchange of field-line partners during the time a field line maps into the diffusion region. In a finite geometry the diffusion regions lie on field lines which connect neutral points of the field configuration, and along which a potential drop is imposed. Although the discussion centers principally on the magnetosphere, the described reconnection process and field topology should also be applicable to other astrophysical problems. (auth)

8604 THREE-DIMENSIONAL MODEL OF MAGNETIC MERGING AT THE MAGNETOPAUSE. Hill, T. W. (Rice Univ., Houston TX). Radio Sci.; 8: No. 11, 915-916(Nov 1973).

The three-dimensional problem of magnetopause merging was analyzed using an extension of Aifvén's neutral-sheet field annihilation model. That model has been generalized for an arbitrary magnitude and direction of the interplanetary magnetic field. The analysis provides a quantitative prediction of the merging rate that is consistent with the observed dependence of geomagnetic activity on the direction and magnitude of the interplanetary magnetic field. (auth)

8605 EXPERIMENTAL STUDY OF THE RECONNECTION PROCESS. Baum, P. J.; Bratenahl, A.; White, R. S. (Univ. of California, Riverside). Radio Sci.; 8: No. 11, 917-920(Nov 1973).

The results of a laboratory field-line reconnection experiment are reviewed. In doing so the flux transfer rate is defined and contrasted with magnetic Mach numbers as measures of the reconnection rate. The origin of the reconnection electric field was examined to determine some of the requirements of non-steady versus steady reconnection. The dependence of various measures of the reconnection rate on electrical conductivity is discussed as well as some experimental features which may relate to previous theory. Finally, some approximate scaling between laboratory events and the geomagnetic substorm are presented. Three major conclusions are reached: (a) The flux transfer rate as a measure of the reconnection rate is different from a magnetic Mach number. (b) The early reconnection process is quasi-steady state or "Petschek-like" and this phase is associated with magnetic energy storage. A later rapid flux transfer event is more energetic and is associated with storm events. The flux transfer event is triggered by a change in resistivity. (c) The laboratory event scales reasonably well to the duration and energy of a substorm. (auth)

8606 MAGNETOSPHERIC FIELD MORPHOLOGY AT MAGNETICALLY QUIET TIMES. Sugiura, M. (Goddard Space Flight Center, Greenbelt, MD). Radio Sci.; 8: No. 11, 921-927(Nov 1973).

The magnetospheric morphology is reviewed using the method of the ΔB topology. Typical examples of ΔB profiles along individual passes of OGO-5 in the morning hours and near noon are given, supplementing similar data presented earlier. These results demonstrate the significance of the equatorial current system in the distortions of the magnetospheric field in its quiet state. A preliminary study of the differences between the observed inclination, I, and I calculated from a reference field, and the corresponding differences in declination, D, shows that ΔI and ΔD are larger than expected from the existing models. The magnitudes of ΔI at low latitudes are larger in the dusk sector than in the dawn sector, suggesting that the equatorial inner magnetosphere is more inflated near dusk than near dawn. The ΔD data show that the bending of the field lines toward the tail is greater in the dusk than in the dawn sector. To account for the large ΔD values at midlatitudes it is suggested that they are caused by field-aligned currents flowing from the dusk end of the cross-tail current to the ionosphere and returning to the tail from the ionosphere on the morning side. (auth)

8607 SPECTRAL COMPOSITION OF GEOMAGNETIC FIELD VARIATIONS IN THE PERIOD RANGE OF 5 MIN TO 2 HR AS OBSERVED AT THE EARTH'S SURFACE. Campbell, W. H. (National Oceanic and Atmospheric Administration, Boulder, CO). Radio Sci.; 8: No. 11, 929-932(Nov 1973).

From geomagnetic records of sixteen observatories distributed about the earth, a spectral analysis of the geomagnetic field was prepared for each day of 1965, a year of relatively quiet solar-terrestrial activity. Field amplitudes were found to increase almost linearly with periods in the 5 min to 2 hr range of study. The northward and eastward components of field are about equal at all latitudes with slightly larger values of H in the auroral and equatorial electrojet region. The vertical component of field is less than the others at all but the auroral zones. Seasonal changes in the amplitude appear at all locations but are more pronounced in the polar cap. Summer solstitial field strengths are about twice those of the winter period. On most quiet days of a month the amplitudes vary from about 0.5 to 0.1 times that of the monthly average levels. On most active days of the month the fields are between 4 to 10 times the size of the average monthly level amplitudes. The greatest variations in these levels occur at the equatorial and auroral zones. The lowest field values occur between 10° and 35° geomagnetic latitude with a minimum near 20° to 25°. Maximum values of the field are found at 65° to 75° geomagnetic latitude. Allowing for induced currents within the Earth and for the global area of the distribution, about 91% of the magnetic energy is found between 60° and 80° geomagnetic latitude, about 4% in the higher latitude polar cap, and only 1% between the equator and 15°. (auth)

8608 HIGH LATITUDE ELECTRIC FIELDS AND THE MODULATIONS RELATED TO INTERPLANETARY MAGNETIC FIELD PARAMETERS. Heppner, J. P. (Goddard Space Flight Center, Greenbelt, MD). Radio Sci.; 8: No. 11, 933-948(Nov 1973).

The meaning and characteristics of basic and average convection (i.e., electric field) patterns are described. The continuous existence of the basic convection pattern argues against treating magnetic field merging mechanisms as the fundamental cause of magnetospheric convection. However, whether related to merging or to some other mechanism, interplanetary magnetic field conditions significantly modulate the distribution, magnitudes, and boundaries of the convection pattern. A previous correlation between azimuthal, ϕ, angles of the interplanetary magnetic field and asymmetries in polar cap electric field distributions as seen by OGO-6 is reviewed. A new approach is taken to reveal correlations with the north–south, θ, angle and magnitude, B, of the interplanetary field as well as additional features which correlate with the ϕ angle. Both significant correlations and conditions which show a lack of correlation are found. Several aspects of the correlations appear to be particularly important. One is that for a given ϕ angle, correlations exist relative to θ independent of B and relative to B independent of θ. A second is that shifts in the latitude of the low altitude limit of the auroral belt convection are strongly correlated with all parameters (ϕ, θ, B). (auth)

8609 GUIDING CENTER MOTIONS OF MAGNETOSHEATH PROTONS OVER THE DAYSIDE POLAR CAP IN A MODEL OPEN MAGNETOSPHERE. Boright, A. L.; Speiser, T. W. (Univ. of Colorado, Boulder). Radio Sci.; 8: No. 11, 949-954 (Nov 1973).

The guiding center equations are solved numerically to follow 200 eV protons with pitch angles near the loss cone from the dayside magnetosheath on the noon meridian to their mirror height in a model open magnetosphere. The effect of magnetic field line curvature and electric field strength upon proton mirror heights is examined and it is found that when the magnetic field has dipole-like curvature along a dayside proton trajectory an increase in the strength of the dawn-dusk electric field will result in an increase of the proton mirror height. When there exists significant nondipole-like magnetic field curvature along a dayside proton trajectory an increase in the dawn-dusk electric field strength can result in lower proton mirror heights. In the model, when the interplanetary magnetic field is directed northward or southward the latitude dependence of changes in proton mirror height resulting from changed dawn–dusk electric field strength is the same along the noon–midnight meridian over the northern and southern polar caps, but when the interplanetary magnetic field vector lies in the noon–midnight meridian plane at an angle to the earth dipole axis, proton mirror height behavior in response to electric field strength changes is different over the northern and southern polar caps. Proton drift perpendicular to the magnetic field but having a component parallel to the electric field can result in kinetic energy changes of up to 25% as a proton moves from the magnetosheath to its mirror height. (auth)

8610 RATE OF EROSION OF DAYSIDE MAGNETIC FLUX BASED ON A QUANTITATIVE STUDY OF THE DEPENDENCE OF POLAR CUSP LATITUDE ON THE INTERPLANETARY MAGNETIC FIELD. Burch, J. L. (Goddard Space Flight Center, Greenbelt, MD). Radio Sci.; 8: No. 11, 955-961(Nov 1973).

By considering only those periods when the delay time from the interplanetary observing position to the magnetosphere is less than about 5 min, it is found that irrespective of substorm activity: (a) the 45-min average value of interplanetary B_z pre-

dicts the latitudes of the poleward and equatorward boundaries of polar cusp electron precipitation with rms errors of 1.34° and 1.16° respectively; (b) both boundaries move equatorward by about 5° as B_z varies from 0 to -6γ, the cusp remaining about 4° wide; (c) the amount of flux added to the polar cap is about 9.2% of the total southward flux impingment on the magnetosphere in the previous 45 min; and (d) as B_z becomes more positive, the equatorward boundary moves only slightly more poleward ($1/2$° between $B_z = 2\gamma$ and $B_z = 6\gamma$), while the poleward boundary moves significantly toward higher latitudes, resulting in a cusp approximately 7° wide for $B_z = 6\gamma$. This dependence of the width of the cusp on positive B_z suggests that reconnection between the IMF (interplanetary magnetic field) and open geomagnetic field lines (which are southward near the dayside magnetopause) is facilitated when the IMF is northward, allowing deeper penetration of magnetosheath plasma into the high latitude magnetosphere. (auth)

8611 IMF SECTOR STRUCTURE EFFECTS ON THE QUIET GEOMAGNETIC FIELD. Matsushita, S. (National Center for Atmospheric Research, Boulder, CO); Tarpley, J. D.; Campbell, W. H. Radio Sci.; 8: No. 11, 963-972(Nov 1973).

A correlation of the interplanetary magnetic field sector structures including the east–west component with the polar geomagnetic field variations has recently been suggested by several scientists. To clarify the details of the correlation and to facilitate discussion of the physical mechanism involved in the interaction, 2.5-min digitized geomagnetic data from 40 stations located from the northern polar cap through the southern subauroral zone were examined for quiet days in 1965. The Sq^P equivalent overhead current systems were investigated with respect to seasonal changes and variations corresponding to toward- and away-sector structures by the technique of spherical harmonic expansions of the data. In addition to obvious seasonal variations of the Sq^P, a clear shift of the average Sq^P pattern toward the afternoon (early morning) side of the polar cap for the toward-sector (away-sector) structure was obtained. Furthermore, small but remarkable sector effects on the quiet geomagnetic field in middle and low latitudes were discovered. The results of this work contribute to the discussion of sector structure effects on magnetic field merging at the magnetopause and convective patterns in the magnetosphere. (auth)

8612 MAGNETOSPHERIC CURRENT SHEETS. Speiser, T. W. (Univ. of Colorado, Boulder). Radio Sci.; 8: No. 11, 973-977(Nov 1973).

A review is presented of theories and observations of current sheets in the magnetosphere, emphasizing the magnetopause and tail current sheets. Theoretical models of the magnetopause current sheet can be divided into two types: specular reflection and fluid models containing no external magnetic field, and models with an interplanetary/magnetosheath magnetic field. Understanding of the first type is much better than of the second, although magnetospheric observations indicate that the external magnetic field plays an important role. Most of the theoretical models of the tail current sheet attempt to arrive at an understanding of the reconnection process or start with the assumption that reconnection is important. Observations are reviewed and implications for the models are discussed. (auth)

8613 PLASMA FLOW IN THE PLASMA SHEET AND ITS RELATION TO SUBSTORMS. Hones, E. W. Jr. (Los Alamos Scientific Lab., NM). Radio Sci.; 8: No. 11, 979-990(Nov 1973).

The substorm-related thinning and thickening of the plasma sheet, processes that have been extensively studied at $X_{SM} \approx -18\ R_E$, occur at all distances in the magnetotail beyond $X_{SM} \approx -10$ to $-15\ R_E$ in most substorms. These processes involve rapid flow of plasma out of and into the magnetotail and suggest the formation of magnetic neutral lines, first near the Earth and then far out in the tail during a substorm. Evidence for these processes is discussed. (auth)

8614 lf RADIO NOISE FROM THE EARTH'S MAGNETOSPHERE. Frankel, M. S. (Stanford Univ., CA). Radio Sci.; 8: No. 11, 991-1005(Nov 1973).

Gyro-synchrotron radio noise emitted by electrons trapped in the magnetosphere has been a subject of extensive research. Previous efforts, which considered frequencies greater than 1 MHz, have shown that this noise should not be detectable in the mf to hf range because its intensity is below the cosmic background noise level. The lf range was investigated and it was found that appreciable noise is generated at these frequencies. In fact, the theoretical results for this lf noise agree very well with experimental data obtained by the Goddard Space Flight Center radio astronomy experiment aboard the IMP 6 spacecraft. A comparison showed that the model predicted both variation in the observed noise intensity with Kp and the noise spectral characteristics. Consequently, it is concluded that detectable lf radio noise is emitted, by means of the cyclotron–synchrotron mechanism, by electrons trapped in the magnetosphere, and that this noise is observable only for frequencies below about 300 kHz. For higher frequencies, the theoretical model and the experimental data reconfirm that this noise is below that of cosmic origin. (auth)

8615 RING CURRENT AND MAGNETIC STORMS. Coroniti, F. V. (Univ. of California, Los Angeles). Radio Sci.; 8: No. 11, 1007-1011(Nov 1973).

The ion-cyclotron turbulent ring current precipitation model of magnetic storms is reexamined in light of recent experimental and theoretical developments. The ring current–plasmapause spatial coincidence results from the proton Alfvén layer shielding of the convection electric field. Observations indicate that the dominant ring current precipitation occurs outside the plasmasphere in agreement with recent theories of the high beta, large anisotropy ion cyclotron and electrostatic ion loss cone waves. Hydrogen arc proton precipitation may be caused by parallel electric fields at the equatorward edge of the auroral oval. During the main phase, convection may be both the source and major sink of the asymmetric rink current. During the rapid recovery phase, neutral-wind-induced convection may be the dominant ring current loss process. At this time there is no definitive evidence that ion cyclotron turbulence inside the plasmapause constitutes a major sink for the ring current or generates a SAR arc by electron Landau damping. (auth)

8616 CONTRIBUTION OF MAGNETOSPHERIC FIELD-ALIGNED CURRENT TO GEOMAGNETIC BAYS AND Sq FIELDS: A COMMENT ON PARTIAL RING-CURRENT MODELS. Fukushima, N.; Kamide, Y. (Tokyo Univ.). Radio Sci.; 8: No. 11, 1013-1017(Nov 1973).

Curved field-aligned currents in the magnetosphere produce a noticeable geomagnetic effect on the Earth's surface not only in the D component but also in the H component. For geomagnetic bays or longitudinal asymmetry of ΔH (deviation in H from its quiet level) during magnetic storms, the constibution from the field-aligned currents is greater than that of a partial ring current. The Sq field also may be appreciably influenced by the field-aligned currents associated with the magnetospheric plasma convection. (auth)

8617 SELF-INDUCED MOTIONS OF THERMAL PLASMA IN THE MAGNETOSPHERE AND THE STABILITY OF THE PLASMAPAUSE. Richmond, A. D. (National Center for Atmospheric Research, Boulder CO). Radio Sci.; 8: No. 11, 1019-1027(Nov 1973).

Significant small-scale convective motions can be generated by the presence of thermal plasma in the magnetosphere. An isolated plasma-filled flux tube at L = 4, of density $3 \times 10^9\ m^{-3}$ and temperature 3000 K, can convect away from the Earth at a velocity on the order of 0.7 $R_E\ hr^{-1}$ at night, due to the electric field it creates. An interchange instability occurs at the plasmapause, with a growth rate on the order of $1.9 \times 10^{-3}\ sec^{-1}$ at night, creating turbulence which tends to destroy the steep plasma density gradient. This instability can explain the gradual decrease of the density gradient observed during periods of decreasing magnetic activity. In order to maintain a steep density gradient, three possibilities are discussed: (a) reduction of the instability growth rate due to enhanced ionospheric conductance; (b) reduction of the growth rate due to the presence of radiation belt plasma and/or a sharp temperature increase at the plasmapause; and (c) rapid radial convergence of large-scale flow due to the presence of an Alfvén layer at the plasmapause. The self-induced convective motions may also be important in the production and/or redistribution of small-scale irregularities of thermal plasma observed both inside and outside the plasmapause. (auth)

8618 INTERPRETATION OF ENERGETIC HEAVY ION FLUXES OBSERVED DURING THE MAGNETIC STORM OF DECEMBER 17, 1971. Cladis, J. B. (Lockheed Palo Alto Research Lab., Palo Alto, CA). Radio Sci.; 8: No. 11, 1029-1033(Nov 1973).

An interpretation is given for the high fluxes of 0^+ ions with energies to 12 keV observed during the magnetic storm of December, 17, 1971. It is suggested that the ions were accelerated initially by the absorption, near the altitude of the 0^+ resonance ($\omega = \Omega_{0^+}$), of ion cyclotron waves amplified at a slightly lower altitude by ring-current protons moving downward along magnetic field lines. The energized ions then moved toward higher altitudes along the field lines where they diffused in pitch angle and energy due to resonant interactions with ion cyclotron turbulence. The gradient of the geomagnetic field plays an important role in the amplification of the ion cyclotron waves at low altitudes. It is shown that ring-current protons

may lose considerable energy while resonating with ion cyclotron waves propagating upward. Conversely, ions may gain substantial energy while resonating with waves propagating downward. The observations of the 0^+ ions are correlated with simultaneous measurements of the ring-current protons, and it is argued that the observed energy loss of the protons near the plasmapause may be due to off-equatorial resonant interactions between the protons and ion cyclotron waves. (auth)

8619 ACTIVE EXPERIMENTS, MAGNETOSPHERIC MODIFICATION, AND A NATURALLY OCCURRING ANALOGUE. Kivelson, M. G.; Russell, C. T. (Univ. of California, Los Angeles). Radio Sci.; 8: No. 11, 1035-1048(Nov 1973).

Active experiments in the magnetosphere include some intended to be primarily diagnostic (barium release, electron guns) and others designed to perturb the system to generate instabilities (vlf or ulf wave injection from ground stations, ionospheric heating). Recently, a scheme has been proposed which would modify the magnetosphere by injecting plasma near the equator beyond the plasmapause and initiating wave–particle instabilities. The expected effects have been examined theoretically. Injection of plasma into this region is also a naturally occurring phenomenon produced by the cross-tail electric fields which are associated with geomagnetic activity. For further investigation of magnetospheric instabilities, the advantages of examining artificially injected plasma (control of time and location of injection and of the volume of plasma injected) contrast with the advantages of studying natural enhancements (no extra payload, frequent occurrence). Thus, the two types of experiments are complementary. In preliminary studies of natural plasma enhancements both ulf and elf emissions have been observed. The elf noise is consistent with generation by the electron cyclotron instability (auth)

8620 SOME NEW THOUGHTS ON MAGNETOSPHERIC SUBSTORMS. Akasofu, S. I.; Kan, J. R. (Univ. of Alaska, Fairbanks). Radio Sci.; 8: No. 11, 1049-1057(Nov 1973).

Several important new observations of magnetospheric substorms now allow one to examine many substorm features in terms of the solar wind–magnetosphere dynamo and of four rates, the merging rate M of the interplanetary and geomagnetic field lines, the transport rate T of the merged field lines from the dayside magnetosphere to the magnetotail, the reconnection rate $\mathcal{R}$ of the transported field lines, and the return rate R of the reconnected field lines to the dayside magnetosphere. (WDM)

8621 SUBSTORMS IN SPACE: THE CORRELATION BETWEEN GROUND AND SATELLITE OBSERVATIONS OF THE MAGNETIC FIELD. McPherron, R. L.; Russel, C. T.; Kivelson, M. G.; Coleman, P. J. Jr. (Univ. of California, Los Angeles). Radio Sci.; 8: No. 11, 1059-1076(Nov 1973).

Satellite studies of magnetospheric substorms are necessarily statistical since there are few properly instrumented satellites in space at any one time. To carry out these studies, one selects an ensemble of similar substorms, determines an origin for substorm time, and performs an ensemble average to eliminate noise. Similarity between different substorms can be determined from contour maps of midlatitude magnetic perturbations as a function of longitude and universal time. The origin of substorm time can also be determined from midlatitude perturbations and is usually taken as the beginning of the positive bay near midnight. Use of these techniques has led to a phenomenological model of magnetospheric substorms that includes a growth phase. The controversy over the existence of the growth phase is at least partially a consequence of differing definitions of the origin of substorm time. Use of auroral zone magnetograms often gives an earlier onset than midlatitude magnetograms. However, midlatitude onsets do appear to order satellite data systematically. The discrepancy between these two onset times is illustrated and it is shown how midlatitude onsets order satellite data in agreement with the growth phase model. Three events of increasing complexity are considered. Each has been previously reported in the literature and later criticized. It is speculated that a polar magnetic substorm begins when a pair of X- and O-type neutral lines form on closed field lines within the plasma sheet. Subsequently, the midlatitude positive bay begins when magnetic merging first encounters open field lines in the lobe of the tail. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 8648, 8700, and 9221.

8622 (AWRE-O-18/73) INVESTIGATIONS OF VACUUM ARC ION SOURCES. Owen, W. D.; Richardson, M. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Apr 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25. UK 50 pence.

Results are presented of some investigations of the properties of vacuum arcs, between deuterided erbium film electrodes deposited on a ceramic substrate, used as ion sources. The sources were operated with arc current pulses in the range 10 to 100 A. The pulse duration was long enough to establish a stable arc but short enough to avoid the occurrence of anode hot spots due to electron bombardment heating. Thus, a diffuse mode of current collection existed at the anode and therefore the investigations were concerned with plasma generated at cathode hot spots. (auth)

8623 (CONF-730833-4) PHOTOELECTRON SPECTROSCOPY OF MOLECULAR BEAMS. Berkowitz, J. (Argonne National Lab., Ill. (USA)). 1973. 20p. Dep. NTIS $3.00.

From chemical spectroscopy and photochemistry in the vacuum ultraviolet conference; Valmorin, Quebec, Canada (5 Aug 1973).

The development of the field of photoelectron spectroscopy and the intensities and angular distributions from which one can infer transition probabilities and phase shifts are discussed. (JFP)

8624 (COO-3129-34) MOLECULAR BEAM APPARATUS FOR STUDENT EXPERIMENTS ON REACTIVE SCATTERING. Conley, R. J.; Greene, E. F.; McInnis, S. M. (Brown Univ., Providence, R.I. (USA). Metcalf Chemical Lab.). 1973. 19p. Dep. NTIS $3.00.

The construction and operation of a simple molecular beam apparatus is described, and some of the results obtained with it for distributions for the reactions $K + Br_2 \rightarrow KBr + Br$ and $K + CH_3I \rightarrow KI + CH_3$. (JFP)

8625 (SLA-73-5636) ION BACKSCATTERING STUDY OF WSi_2 LAYER GROWTH IN SPUTTERED W CONTACTS ON SILICON. Borders, J. A.; Sweet, J. N. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 19p. (CONF-731028-2). Dep. NTIS $3.00.

From international conference on applications of ion beams to metals; Albuquerque, New Mexico, USA (2 Oct 1973).

Helium ion backscattering was used to study the reaction kinetics in samples composed of thin (~2200 Å) W films dc sputtered onto chemically cleaned P or B doped ⟨111⟩ single crystal Si substrates. At temperatures in the range 625°C–750°C, Si is observed to migrate into the W films and form a well-defined WSi_2 reaction layer. Typically, at 650°C, about 750 Å of W is consumed in four hours. A detailed comparison of the backscattering spectra indicates that the WSi_2 reaction layer grows approximately as t^n where $n \approx 1$ during the initial growth but then decreases to $n \simeq 1/2$ when the W films are over 30% reacted. An activation energy which characterizes the initial stage of WSi_2 layer growth is 63–71 kcal/mole for 35% W film reaction (2000 Å WSi_2 formed). This activation energy is somewhat higher than the 50 kcal/mole reported by other investigators for WSi_2 layer growth at temperatures over 850°C where layer growth was observed to be governed by $t^{1/2}$ kinetics. A preliminary estimate of the activation energy governing the beginning of the $t^{1/2}$ layer growth observed here is 60 ± 15 kcal/mole. Prior to complete reaction of W films aged in the temperature range 625°C–730°C, an upper limit of 2 at.% Si is observed for the Si concentration in the unreacted portion of the W film. (auth)

8626 ELECTRON–MOLECULE SCATTERING. Herzenberg, A. (Yale Univ., New Haven). pp 261-284 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

The resonance scattering of electrons off molecules is discussed. The important shape resonances in H_2, N_2, and O_2 are discussed along with various attempts to calculate the properties of these shape resonances. Applications of the impulse approximation for calculating cross sections are treated. (LBS)

8627 PANEL DISCUSSION: ELECTRON–MOLECULE COLLISIONS. pp 285-313 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

Some of the topics discussed in the panel discussion on electron–molecule collisions include rotational resonances, calculations of the potential interaction between the electron and the hydrogen molecule, and the adiabatic-nuclei theory of $e-N_2$ scattering. (LBS)

8628 PRODUCTION OF INTENSE MICROSECOND RELATIVISTIC ELECTRON BEAMS. Bugaev, S. P.; Kassirov, G. M.; Koval'chuk, B. M.; Mesyats, G. A. (Inst. of Atmospheric Optics, Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 2, 46-47(20 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 2, 82-85(20 Jul 1973).

An electron current up to 5 kA with pulse duration up to 4 μsec was obtained in a diode with a multiple-tip cold-emission cathode. The possibility of increasing the current–pulse duration is discussed. (auth)

8629 PRODUCTION OF AN Fe^- BEAM BY CATHODE SPUTTERING IN A PENNING SOURCE. Dumail, M.; Lottet, G. C. (Institut de Physique Nucleaire, Orsay, France). Nucl. Instrum. Methods; 112: No. 3, 607-609(1973). (In French).

An intrinsic disadvantage of ion sources with cathodes (sputtering) has been used for production of negative iron ions. (auth)

8630 DISCHARGE IN A HOLLOW GRAPHITE CATHODE AS AN ION SOURCE. Ibadov, S.; Dubinina, E. M. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 12, 2118-2120(Dec 1972).

Translated from Radiotekh. Elektron.; 17: No. 12, 2630-2631 (Dec 1972).

The characteristics of a source using a hollow cathode made of graphite are discussed including the design, volt–ampere characteristics of the discharge, ion current, and the performance. (JFP)

8631 ION BEAM APPARATUS IN THE RANGE OF keV ENERGIES. Ishitani, T.; Shimizu, R. (Osaka Univ., Suita, Japan). Jap. J. Appl. Phys.; 12: No. 6, 926-927(Jun 1973).

A compact ion beam apparatus is described for analysis of surfaces. The accelerating energy reaches 50 keV, and permanent magnets are used for both ion source and analyzer. The I_T-V_{AA} characteristic at 35 keV is given. The spectrum of the soft x rays produced by H_2^+ bombardment of thick graphite at 45 keV is given. Sputtering and blocking patterns are given for Cu(III) bombarded by Ar^+ at 10 keV and Cu(110) by H_2^+ at 35 keV, respectively. (DLC)

8632 NONLINEAR INTERACTION BETWEEN SPACE CHARGE WAVES AND TRAPPED ELECTRONS. Ivanov, A. A.; Korshunov, S. M.; Beryuleva, N. S.; Tarasov, S. P. (Moscow Physical-Technical Inst.). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1857-1865(Nov 1973). (In Russian).

The interaction between an intensive electron beam and a relatively small amount of electrons trapped in a potential well is considered by the method of partial numerical modeling. It is found that for a shallow potential well $w_2/w_1 \leq 10^{-2}$ (w_2 is the trapped electron energy and w_1 the electron energy in the beam), a "monochromatic" space charge wave is unstable with respect to excitation of satellites of shorter wave length. With increase of the potential well depth ($w_2/w_1 \gg 10^{-2}$) a wave with maximal increment becomes predominant in the space charge wave packet. The nonlinear interaction stage is characterized by heating of electrons trapped in the potential well. (auth)

8633 SPECTRAL SPATIAL AND ANGULAR DISTRIBUTION OF ^{137}Cs GAMMA-RAYS BACKSCATTERED FROM Be, C, AND Al. Pozdneev, D. B.; Faddeev, M. A. (Gorky State Univ., USSR). Kernenergie; 16: No. 4, 105-111(Apr 1973). (In Russian).

Spectral angular distribution of ^{137}Cs gamma-rays backscattered from different sections of the surface of a semi-infinite Be, C, and Al reflector were determined by Monte-Carlo method. Contributions of single-, double-, and multiple-scattered gamma-rays to gamma-ray albedo are quantitatively characterized. The obtained differential and integral characteristics were analyzed. (auth)

Atomic and Molecular Properties

Refer also to abstracts 9687 and 9712.

8634 CONFERENCE ON THE INTERACTION OF ELECTRONS WITH STRONG ELECTROMAGNETIC FIELD, BALATONFUERED, HUNGARY, SEPTEMBER 11–16, 1972. Invited Papers. Budapest; Central Research Institute for Physics (1972). 348p. (CONF-720976-).

The conference included 12 papers. Separate abstracts were prepared for two papers. Other papers were outside the subject scope of NSA. (JFP)

For abstracts of individual papers see: 8695 and 9267.

8635 ANALYSIS OF THE $2s^2\ ^1S$, $2p^2\ ^1D$, AND $2s2p\ ^1P$ AUTOIONIZING LEVELS OF HELIUM, IN PROTON–HELIUM COLLISIONS. Bordenave-Montesquieu, A.; Gleizes, A.; Rodiere, M.; Benoit-Cattin, P. (Paul Sabatier Univ., Toulouse). J. Phys., B (London); 6: No. 10, 1997-2009(Oct 1973).

Using Fano's formula, the three resonances associated with the $2s^2\ ^1S$, $2p^2\ ^1D$ and $2s2p\ ^1P$ autoionizing levels of helium were parametrized. They were observed in energy spectra of ejected electrons produced by proton-helium collisions. For the ^1S resonance, the variations with electron emission angle of the shape parameter q and the resonant continuum cross section σ_r, in the angular range 16.5 to 160°, for 150-keV protons were determined. The dependence on proton energy of these parameters was also obtained for 16.5° angle, in the energy range 14 to 150 keV. Additional results concern the variation of the profile parameters for ^1D and ^1P resonances, with ejection angle, at 150 keV. (auth)

8636 SHAPE OF THE $1^1S_0–2^1P_1$ FANO RESONANCE IN THE H-PHOTOIONIZATION CONTINUUM. Rudkjoebing, M. (Ole Roemer-Observatoriet, Aarhus, Denmark). J. Quant. Spectrosc. Radiative Transfer; 13: No. 12, 1479-1501(Dec 1973).

The interaction between the discrete autoionized state 1s2p of negative hydrogen and the overlapping split-configuration continuum is described in terms of stationary perturbations of nonorthogonal states that are eigenstates of two different first-order approximations to the Hamilton operator for the system. The eigenfunctions for the split-configuration states are taken to be those of a free p electron outside a neutral hydrogen atom in the ground state. The eigenfunction adopted for the short-lived, closed 1s2p configuration is the product of two functions that belong to symmetric Hartree-Fock eigenfunctions for the $1s^2\ ^1S$ and $2p^2\ ^1D$ states, respectively. This eigenfunction defines that Hamilton-operator approximation, of which the 1s2p state is an eigenstate. An improved Hamilton operator defines two different, but not independent, perturbation functions, one of which is a measure of the instability of the 1s2p configuration. The width of the resonance is found, correspondingly, to be determined by the product of two different perturbation terms. They are calculated in a Hartree-type approximation and found to be small, in part due to an effect of the nonorthogonality of the unperturbed states. The mean position of the singlet and triplet P Fano resonances in the ground state absorption continuum of H^- is found to be close to that of the diffuse interstellar bands λ 4430 and λ 4760, but the calculated distance is about four times that of the bands. With exchange neglected and the position of maximum absorption fixed at λ 4430 the singlet P resonance is found to have a width of 43 Å at half maximum, a minimum on the short-wave-length side, and a top absorption coefficient of 7×10^{-16} cm²/ion, corresponding to an f value equal to 0.27. Tables of Hartree-Fock functions for the $2s^2\ ^1S$, and the $2p^2\ ^1S$, ^1D and ^3P states of H^-, calculated by Claus Ingemann-Hilberg, are given. (auth)

8637 FESHBACH-TYPE $^3P^e$ AUTOIONIZING STATES OF H^-. Holoeien, E.; Midtdal, J. (Univ. of Oslo). J. Phys., B (London); 6: No. 10, 1992-1996(Oct 1973).

The combined multiconfiguration energy-bound-natural eigenvalue (MCEB-NEV) method was applied to Feshbach-type $^3P^e$ autoionizing states of H^- pertaining to the n = 3 and n = 4 thresholds. The lowest-lying state of each cluster was found to have appreciably positive binding energy compared with that of the $(2p^2)^3P^e$ state below the n = 2 threshold. The magnitudes of the binding energies are a little smaller than those of the $H^-\ ^1S^e$ compound resonant states pertaining to the n = 3 and n = 4 thresholds. (auth)

8638 NUCLEAR CHARGE EXPANSION METHOD FOR $1snl^1\ ^3L–1sn'l'^1\ 3L'$ TRANSITIONS IN THE HELIUM ISOELECTRONIC SEQUENCE. Laughlin, C. (Univ. of Nottingham, Eng.). J. Phys., B (London); 6: No. 10, 1942-1952(Oct 1973).

The first two terms in the Z-expansion of matrix elements of the electric dipole transition operator for all $1snl^{1,3}L–1sn'l'^{1,3}L'$ transitions in the helium isoelectronic sequence with $n,n' \leq 4$ are calculated. It is demonstrated that an arbitrary screening parameter in a modification of the screening approximation of Dalgarno and Stewart (Proc. R. Soc. A.; 257: 534-40 (1960)) can be chosen to increase the rate of convergence of the expansion. A practical procedure for choosing the arbitrary screening parameter is presented. (auth)

8639 RESONANCE BROADENING IN THE SINGLET SPECTRUM OF He. Camm, D. M.; Copley, G. H. (Univ. of British Columbia, Vancouver). J. Quant. Spectrosc. Radiative Transfer; 13: No. 12, 1251-1260(Dec 1973).

Resonance broadening of the 7281 and 6678 Å He lines emitted from a gas discharge at pressures around 1 atm was measured at a temperature of about 500°K. Temperatures in the discharge were obtained by recording the intensity distribution of the $^3\Pi_g – {}^3\Sigma_u^+ (v' = 0, v'' = 0)$ band of He_2 at 4650 Å and the $^2\Sigma_u^+ – {}^2\Sigma_g^+ (v' = 0, v'' = 0)$ band of N_2^+ at 3914 Å. Analysis of the asymmetry of the He line profiles shows that the impact approximation is no longer a valid description of the collision process at the He densities encountered in this experiment. The self broadening constant of the 2^1P state in He was derived from the widths of the resonance-broadened profiles after correction for residual van der Waals broadening. (auth)

8640 ELECTROSTATIC FINE STRUCTURES OF HELIUM RYDBERG STATES. Chang, T. N.; Poe, R. T. (Univ. of California, Riverside). Phys. Lett., 45A: No. 6, 477-478(5 Nov 1973).

The physical origin of the electrostatic fine structures of helium Rydberg states is studied. The perturbation theory result is in excellent agreement with the recent high resolution microwave-optical resonance experiment of Wing and Lamb. (auth)

8641 DATA FOR GRAPHICAL RESOLUTION OF TWO OVERLAPPING X RAY EMISSION LINES. Natural Widths of $K\alpha_{1,2}$ of the Elements Z = 10 to 92. Pessa, V. M. (Univ. of Turku, Finland). X-Ray Spectrom.; 2: No. 4, 169-172(Oct 1973).

The energy difference between two overlapping x-ray emission lines with Lorentzian shapes was calculated as a function of the total line profile for several combinations of intensity ratio and half width ratio of the component lines. Natural line widths of $K\alpha_1$ and $K\alpha_2$ for neon to uranium are listed from available literature values. (auth)

8642 $M_{4,5}$ SPECTRUM OF Ce AND THE $\gamma–\alpha$ PHASE TRANSITION. Ottewell, D.; Stewardson, E. A.; Wilson, J. E. (Univ. of Leicester, Eng.). J. Phys., B (London); 6: No. 10, 2184-2196(Oct 1973).

Absolute absorption coefficients in the region of the M_4 and M_5 edges are presented for cerium in CeF_3, CeO_2, and in the metal. Strong line absorptions (3d → 4f) occur to the low energy side of weak M_4 and M_5 "edges." At each "edge" the absorption passes through a weak broad peak attributed to transitions into a band of higher f states. The spectra of CeF_3 and the metal at room temperature are structurally similar but differ clearly from the quadrivalent oxide. A shift to higher energy is found for both absorption lines and edges in the sequence fluoride–oxide–metal at room temperature. On cooling the evaporated metal absorption foil (γ phase) to 77°K both M_4 and M_5 line profiles change into forms accurately resolvable into a combination of trivalent (CeF_3 like) and quadrivalent (CeO_2 like) curves, suitably displaced in energy, in the proportions 59% to 43%, respectively. This is interpreted as evidence for the transfer of localized 4f electrons from some of the 3+ ions of the γ phase when the $\gamma–\alpha$ transformation occurs. The line structure exhibits hysteresis and reverts to that of the original γ phase after repeated cycling between 77°K and room temperature. The possibility of superlattice structure in α-cerium is discussed. (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

8643 (CONF-730955-1) STUDY OF THE ELECTRON DONOR–ACCEPTOR PROPERTIES OF DIAMAGNETIC ORGANIC MOLECULES VIA POSITRONIUM REACTIONS. Madia, W. J.; Nichols, A. L.; Ache, H. J. (Virginia Polytechnic Inst., Blacksburg (USA). Dept. of Chemistry). 1972. 5p. Dep. NTIS $3.00.

From 11th international symposium on free radicals; Berchtesgaden, F.R. Germany (4 Sep 1973).

The results of a preliminary study of the interactions of positronium with nitrobenzene and ortho, meta, and para derivatives of nitrotoluene and dinitrobenzene in benzene solutions are reported. Distinct differences in the rate constants for the reaction of positronium with the organic molecules were observed for the various systems, and an attempt was made to correlate these changes to certain molecular parameters and to the effects of steric interactions in these molecules. (JFP)

8644 (JINR-P14-7359) INVESTIGATION OF INTRAMOLECULAR ELECTRON EFFECTS IN ORGANIC COMPOUNDS USING THE π^--MESON CAPTURE BY HYDROGEN. Gol'danskii, V. I.; Zatsepina, N. N.; Petrukhin, V. I.; Risin, V. E.; Suvorov, V. M.;

Tupitsyn, I. F.; Kholodov, N. I.; Yutlandov, I. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The probabilities W, of the π^--meson capture by the fragments of $Z_mH_nZ'_kH'_n$ molecules of different classes with hydrogeneous substituent group are measured. Technique of W determination is based on the use of ordinary and selectively deuterated compounds. It is found that the coefficients a_{H-Z} in the frame and functional groups differ strongly due to the mutual influence of fragments. In the row of CH_3X and C_6H_5X substitution derivates the correlation treatment of $a^{CH_3}_{H-C}$ and $a^{C_6H_5}_{H-C}$ is performed with the help of the Hammet-Taft type equations. The presence of the linear correlations with the induction σ_I-constants of substitutes and their absence when comparing the a_{H-C} coefficients with other sets of σ-constants proves the dominant role of the induction effect. (auth)

8645 (JINR-P14-7361) INFLUENCE OF IONICITY BONDS AND ACID PROPERTIES OF HYDROGENEOUS COMPOUNDS ON π^--MESON CAPTURE BY HYDROGEN. Gol'danskii, V. I.; Zatsepina, N. N.; Petrukhin, V. I.; Risin, V. E.; Suvorov, V. M.; Tupitsyn, I. F.; Kholodov, N. I.; Yutlandov, I. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

For a wide row of CH-, OH- and NH-acid the presence of correlations between the experimentally determined coefficients a_{H-Z} of the model of "large mesic molecules" and the constants of autoprotolis in the interval pK_s from −1.7 to 42 is shown. (auth)

8646 (KFK-EXT-3/73-3) MEASUREMENTS ON KAONIC ATOMS. Koch, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). May 1973. 122p. (In German). Dep. NTIS (U. S. Sales Only) $8.25.

A survey of the existing measurements on x-rays of kaonic atoms is given, yielding information about properties of the negatively charged kaon itself (mass and electric polarizability), about the kaon–nucleon interaction near the threshold and the distribution of nucleons at the nuclear surface. The relation between the physically interesting quantities and the measured quantities is described. Corrections are discussed in detail. Experimental methods are discussed. Experimental results are given and compared to theoretical predictions. A table showing the energies, natural widths and intensities of the most important kaonic transitions measured so far is presented. A value for the K^--mass with a relative accuracy of 8×10^{-5} is given: $m_{(K^-)} = (4.93.691 \pm 0.040)$ MeV, together with an upper limit for the K^--polarizability. Part of the data can be interpreted in the so far still mode l-dependent way, namely that for light nuclei, a distribution which at the surface of the nucleus drops a little faster than a Fermi-distribution, fits the real nucleon distribution quite well. The dependence of the measured quantities on the nucleon distribution is discussed and it is shown that for heavy nuclei, differences of some percent between the RMS-radii of neutron and proton distributions should yield measurable effects. (GE)

8647 (NP-19806) CORRECTIONS FOR POSITRON ANNIHILATION IN FLIGHT IN NUCLEAR SPECTROMETRY. Kantele, J.; Valkonen, M. (Jyvaeskylae Univ. (Finland). Dept. of Physics). Mar 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

Theories of positron single and two-quanta annihilation in flight, the Fermi beta decay theory, and theories of positron energy loss are used in calculations of total probabilities of annihilation in flight of positrons in continuous spectra. The results are given in a nomogram useful in correcting for positron annihilation in flight in various nuclear spectrometry experiments. Confirmation of the theoretical basis employed was obtained by comparing total absolute probabilities for annihilation in flight of ^{62}Cu positrons in Perspex, copper, cadmium and lead, using a new differential method. The agreement with the theory was found to be excellent. A method for obtaining "correct" positron energy spectra with scintillation or semiconductor detectors is proposed. (auth)

8648 SLOW POSITRON COLLISION IN GASES. Massey, H. S. W. (University Coll., London). pp 189-212 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

Some theoretical and experimental aspects of various collision processes associated with positrons are discussed. The topics covered include: observable quantities; mathematical formulae for cross sections; the slowing down of positrons in gases–positronium formation; experimental detection of positrons and positron annihilation; the measurement of total cross sections for collision of positrons with gas atoms; annihilation spectrum; and positron annihilation at low temperatures. (LBS)

8649 CORRELATION OF ORTHOPOSITRONIUM ANNIHILATION WITH SURFACE TENSION IN LIQUIDS AND LIQUID MIXTURES. Levay, B. (Eoetvos Univ., Budapest); Hautojaervi, P. J. Phys. Chem.; 77: No. 18, 2229-2233(30 Aug 1973).

The empirical relation between the pick-off annihilation rate of the orthopositronium atom and the surface tension of molecular liquids published recently by Tao was found to be valid also in binary mixtures of water with methanol and dioxane. With the aid of the surface tension the pick-off rate was correlated with the parachor. From the additivity of the parachor a new additivity rule was derived for the pick-off rate. It is valid for both molecular liquids and binary mixtures. The connection to the parachor indicates also that the square root of the pick-off lifetime is a linear function of temperature and of the inverse of the viscosity. This simple law was found to be compatible with several earlier experimental results. (auth)

8650 K^- MESIC ATOMS AND NUCLEAR STRUCTURE. Frank, W. Athens, OH; Univ. of Ohio (1973). 146p. University Microfilms Order No. 73-25,743.

Thesis (Ph. D.).

It is determined to what extent the experimentally observed yields for K^- x-ray transitions in competition with nuclear capture can be accounted for without assuming that neutrons extend beyond the conventional nuclear radius which is determined from experiments which measure only the charge distribution of the nucleus. K^--nuclear capture rates, K^- x-ray transition rates, and yields for the K^- x-ray transitions in competition with nuclear capture are calculated for selected nuclei and K^- states. Special attention is devoted to the role of the Y_0^1 (1405) resonance in the K^- absorption process, and the capture rates and yields are calculated with and without taking this resonance into account so that an assessment of its significance for K^--nuclear capture can be made. Several miscellaneous corrections to the capture rate are considered; these include relativistic effects, deformation of the nuclear matter distribution, and deformation of the nuclear charge distribution. The effect of these corrections on the capture rate is studied in the case of the deformed nucleus, ^{158}Gd, for which a large discrepancy between the experimental and theoretical yields exists, that is, calculated capture rates are a factor of fifty too low. (Diss. Abstr. Int., B)

8651 ORTHO-POSITRONIUM ANNIHILATION: STEPS TOWARD COMPUTING THE FIRST ORDER RADIATIVE CORRECTIONS. Kaufmann, S. K. Pasadena, CA; California Inst. of Tech. (1973). 98p. Microfilms Order No. 73-26,467.

Thesis (Ph. D.).

The 0.2% experimental accuracy of the 1968 Beers and Hughes measurement of the annihilation lifetime of ortho-positronium motivates the attempt to compute the first order quantum electrodynamic corrections to this lifetime. The theoretical problems arising in this computation are here studied in detail up to the point of preparing the necessary computer programs and using them to carry out some of the less demanding steps–but the computation has not yet been completed. Analytic evaluation of the contributing Feynman diagrams is superior to numerical evaluation, and for this process can be carried out with the aid of the Reduce algebra manipulation computer program. The relation of the positronium decay rate to the electron-positron annihilation-in-flight amplitude is derived in detail, and it is shown that at threshold annihilation-in-flight, Coulomb divergences appear while infrared divergences vanish. The threshold Coulomb divergences in the amplitude cancel against like divergences in the modulating continuum wave function. Using the lowest order diagrams of electron-positron annihilation onto three photons as a test case, various pitfalls of computer algebraic manipulation are discussed along with ways of avoiding them. The computer manipulation of artificial polynomial expressions is preferable to the direct treatment of rational expressions, even though redundant variables may have to be introduced. Special properties of the contributing Feynman diagrams are discussed, including the need to restore gauge invariance to the sum of the virtual photon-photon scattering box diagrams by means of a finite subtraction. A systematic approach to the Feynman-Brown method of decomposition of single loop diagram integrals with spin-related tensor numerators is developed in detail. This approach allows the Feynman-Brown method to be straightforwardly programmed in the Reduce algebra manipulation language. The fundamental integrals needed in the wake of the application of the Feynman-Brown decomposition are exhibited and the methods which were used to evaluate them–primarily dispersion techniques–are briefly discussed. Finally, it is pointed out that while the techniques discussed have permitted the computation of a fair number of the simpler integrals and diagrams contributing to the first order correction of the ortho-positronium annihilation rate, further progress with the more complicated diagrams and with

the evaluation of traces is heavily contingent on obtaining access to adequate computer time and core capacity. (auth)

8652 ACCURATE MEASUREMENT OF THE NATURAL DECAY RATE OF ORTHOPOSITRONIUM. Coleman, P. G.; Griffith, T. C. (University Coll., London). J. Phys., B (London); 6: No. 10, 2155-2161(Oct 1973).

The natural decay rate of orthopositronium was measured to an accuracy of 0.20% using a fast counting technique and modified method of analysis. The quenching coefficients for orthopositronium and Z_{eff} for free positron annihilation in freon, argon, nitrogen and krypton were also measured. (auth)

8653 ATOMIC CAPTURE OF NEGATIVE MESONS IN HYDROGEN CONTAINING COMPOUNDS. Gol'danskii, V. I.; Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S.; Frontas'eva, M. V.; Kholodov, N. I. (Inst. of Chemical Physics, Moscow). Dokl. Akad. Nauk SSSR; 211: No. 2, 316-318(11 Jul 1973). (In Russian).

An attempt was made to discover any possible regularity in the distribution of negative, μ^-, mesons between negative groups, Z_mH_n, and atoms, Z', in substituted organic and general hydrogen-containing compounds of the type $Z_mH_nZ_k'$ or $Z_mHZ_k'H$. For all ionic molecules studied—ammonium halides and alkali metal, Ca, and Al hydroxides—a deviation from the Z law was observed with attachment of the μ^- mesons chiefly to NH_4^+ and OH^- (hydrogen-containing) groups. With aliphatic chlorine-substituted simple hydrocarbons with covalent bonds, there was also a marked deviation from the Z law with a high preference for attachment of the mesons to the hydrocarbon chain. The relative probabilities of meson capture by hydrogen-containing compounds are tabulated for 20 compounds. (TTT)

8654 POSITRONIUM AND MUONIUM. Hughes, V. W. (Yale Univ., New Haven). (1973). vp.

From 37th meeting of physicists; Hamburg, Germany (24 Sep 1973).

A review is given of the properties of free positronium, with special emphasis being given to the latest values obtained by measurements. The properties discussed include the fine structure (Feynman diagrams for ground state Ps), Zeeman energy levels in the n = 1 and n = 2 states, the annihilation rates of ground state positronium in gases and porous materials. The discussion of properties of muonium is mainly concerned with the hyperfine structure interval in the ground state and the Zeeman effect which determines the muon spin and muon magnetic moment. The measurements of both positronium and muonium were made mainly by microwave resonance or magnetic resonance experiments respectively. A comparison of the fine structure constant, as found by the different precision measurements, is made. The behavior of positive muons in liquid He is briefly discussed with respect to free muon precession, muonium Larmor precession, and for depolarization of the muon spin. (GE)

Collision Phenomena

Refer also to abstracts 8624 and 8635.

8655 (CEA-R-4486) STUDY OF THIN INSULATING FILMS USING SECONDARY ION EMISSION. Hilleret, N. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Oct 1973. 164p. (In French). Dep. NTIS (U. S. Sales Only) $10.25.

Thesis.

Secondary ion emission from insulating films was investigated using a CASTAING-SLODZIAN ion analyzer. Various different aspects of the problem were studied: charge flow across a silica film; the mobilization of sodium during ion bombardment; consequences of the introduction of oxygen on the emission of secondary ions from some solids; determination of the various characteristics of secondary ion emission from silica, silicon nitride and silicon. An example of measurements made using this type of operation is presented: profiles (concentration as a function of depth) of boron introduced by diffusion or implantation in thin films of silica on silicon or silicon nitride. Such measurements have applications in microelectronics. The same method of operation was extended to other types of insulating film, and in particular, to the metallurgical study of passivation films formed on the surface of stainless steels. (auth)

8656 (COO-3129-35) EXPERIMENTAL CHEMICAL KINETICS: A STUDY OF CHEMICAL REACTIONS BY MEANS OF MOLECULAR BEAM TECHNIQUES. Progress Report, October 1972—October 1973. Greene, E. F. (Brown Univ., Providence, R.I. (USA)). 1973. Contract AT(11-1)-3129. 14p. Dep. NTIS $3.00.

The unfolding of molecular beam scattering data to yield cross sections, the interpretation of the amplitudes of the glory oscillations in the velocity dependence of the total cross section and the construction of a simple molecular beam apparatus for student experiments on reactive scattering are described in publications. Inelastic scattering of CsCl and CsI by Ar and Xe are studied over a range of relative kinetic energy of 1 to 2 kcal $mole^{-1}$ at several laboratory angles. The inelastic cross sections are a substantial fraction of the elastic cross sections at large angles. Beams of halogen containing molecules produce negative ions when they hit surfaces of Nb and LaB_6. On the latter the efficiency of formation of negative ions can be as great as 0.1 for iodides and still larger for bromides. Experiments have shown that a beam of CH_2Cl_2 molecules can be accelerated without significant attenuation by interaction with a beam of electrons. The increase in velocity was up to 20%. Attempts to study the elastic cross sections for the scattering of halogen atoms by the rare gases and the reactive cross sections for the scattering of molecules with internal excitation are continuing. A list of publications is included. (auth)

8657 (COO-3235-22) STANDING WAVE SOLUTIONS TO THE INHOMOGENEOUS EQUATION FOR IDENTICAL PARTICLE SCATTERING. Kouri, D. J.; Levin, F. S. (Illinois Univ., Urbana (USA). School of Chemical Sciences; Weizmann Inst. of Science, Rehovoth (Israel); Delhi Univ. (India). Dept. of Physics and Astrophysics; Brown Univ., Providence, R.I. (USA). Dept. of Physics). 1973. 22p. Dep. NTIS $3.25.

The standing wave solution to the inhomogeneous equation describing identical particle scattering is re-examined. Although the form of that solution is correct, its content is shown to be incorrect. A paradigm for constructing the correct solution, based on unitarity, is discussed, and the proper solution is then obtained. A comparison of different standing wave solutions with differing K operators is given. The results are shown to be an extension to the multi-channel case of those derived previously for the potential well case. (auth)

8658 (ORO-2591-70) FORMATION OF EXCITED HYDROGEN ATOMS BY CHARGE TRANSFER AND DISSOCIATION. Progress Report No. 9, December 1, 1972—November 30, 1973. Thomas, E. W.; Sauers, I.; Carr, W. A. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 30 Nov 1973. Contract AT-(40-1)-2591. 28p. Dep. NTIS $3.50.

Research on the formation of excited hydrogen atoms by charge transfer and dissociation is summarized. A list of publications is included. (JFP)

8659 (ORO-4325-6) IONIZATION PHENOMENA. Progress Report, January 1—November 30, 1973. Watson, R. L. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.). 1973. Contract AT(40-1)-4325. 72p. Dep. NTIS $5.75.

Experimental and theoretical research on ionization phenomena in heavy-ion—atom collisions is summarized. A list of publications is included. (JFP)

8660 (UCRL-75094) EXCITATION STATES OF PROJECTILES MOVING THROUGH SOLIDS. Fortner, R. J.; Garcia, J. D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Sep 1973. 16p. (CONF-730958-1). Dep. NTIS $3.00.

From 3rd international conference on atomic collisions in solids; Gatlinburg, Tennessee, USA (23 Sep 1973).

X-ray spectral measurements of S, Cl, and Ar atoms moving in solid carbon targets are used to extract the equilibrium distribution of vacancies in the valence and L-shells of the projectiles. It is found that the state of excitation is much higher than the mean charge measured after the projectile has left the solid. A simple model is used to deduce the expected final charge state distribution, and these are compared to thin foil measurements. The results support the Betz—Grodzins model for ions moving in solids. (auth)

8661 VARIATIONAL PRINCIPLES AND ATOMIC SCATTERING. Spruch, L. (New York Univ., NY). pp 213-227 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

Three topics that center on the development and use of variational principles and variational bounds are discussed. The first is the determination, within the framework of the Schroedinger equation, of the velocity dependence of transfer cross sections at very high energies. The second is the possibility of using the adiabatic approximation to determine the other, more difficult bound; for the energy, for example, this would be a variational lower bound. The third is the use of a variational principle to estimate the diagonal and off-diagonal matrix elements of a known linear Hermitian operator with respect to Schroedinger wave functions that are well defined but inexactly known. (LBS)

8662 PANEL DISCUSSION: SPIN POLARIZATION EFFECTS IN ATOMIC PROCESSES. pp 229-260 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

Some of the most important recent results of spin and polarization effects in atomic collision and atomic photoionization processes are discussed. The various techniques for separating different types of electromagnetic interactions from each other by using polarized electrons and polarized atoms in a collision experiment are described. Two special examples for polarization effects in atomic photoionization processes are discussed--the Fano effect and multi-photon ionization processes. (LBS)

8663 PHOTOIONIZATION WITH MOLECULAR BEAMS. Cairns, R. B.; Harrison, H.; Schoen, R. I. (Boeing Scientific Research Labs., Seattle). Advan. At. Mol. Phys.; 8: 131-162 (1972).

With molecular beam target gases, photoionization processes were studied to wavelengths as short as 150 Å. No fundamental limitation prevents an extension over the experimentally difficult gap bridging ultraviolet and x-ray techniques. Photoelectron transitions at energies of a few tens of electron volts, but below the Born limits, show many complexities and promise informative surprises. (auth)

8664 ELECTRON DETACHMENT IN COLLISIONS OF H^- WITH ATOMIC AND MOLECULAR TARGETS. Risley, J. S. Seattle, WA; Univ. of Washington (1973). 306p. University Microfilms Order No. 73-27,682.

Thesis (Ph. D.).

An experiment in which the energy and angular distribution of continuum and discrete electrons detached from H^- in 100 eV to 10 keV collisions with atomic and molecular gas targets is described. Absolute total electron detachment cross sections for H^- incident on He, Ar, H_2, N_2 and O_2 were determined between 200 eV and 10 keV. Differential energy loss measurements (between 10 and 35°) of 100 eV to 1000 eV H^- on He revealed no excitation of He. The doubly stripped H^- energy spectra showed that the average kinetic energy of both detached electrons was 4 to 10 eV. The energy and angular distributions of electrons detached from H^- in 200 eV to 10 keV collisions with He, Ar, H_2, N_2 and O_2 were measured between 1 and 100 eV and from 30 to 150°. The energy and width of collisionally produced H^- autodetaching states were found comparable to previous theoretical predictions and experimental observations. An asymmetric angular distribution about 90° was observed for the H^- autodetaching states produced in collisions below 1 keV. Absolute excitation cross sections for H^- and Ar^- autodetaching states were measured between 100 eV and 10 keV. (Diss. Abstr. Int., B)

8665 SCATTERING OF γ-RAYS BY GERMANIUM K-SHELL ELECTRONS. Experimental Set-Up. Pradoux, M.; Meunier, H.; Bauman, J.; Roche, G. (Univ., Clermont, France). Nucl. Instrum. Methods; 112: No. 3, 443-447(1973).

The new interest of a study of the incoherent γ-ray scattering on bound electrons is pointed out. An experimental set-up is described; it allows angular- and energy-distribution measurements on germanium K-shell electrons. Performances and preliminary results obtained with an incoming energy of 662 keV are given. (auth)

8666 ELECTRON CAPTURE IN BEAM-FOIL SPECTROSCOPY. Wei, C. C. (National Tsing Hua Univ., Hsinchu, Taiwan). Nucl. Instrum. Methods; 112: No. 3, 423-426(1973).

The cross section for electron capture by protons for a carbon foil is calculated in Born approximation for application in beam-foil spectroscopy. The cross section in Oppenheimer-Brinkman-Kramer approximation is proportional to E^{-4}, where E is the incident proton energy in high energy limit. Nuclear contribution is also discussed. (auth)

8667 TWO-PHOTON DETACHMENT CROSS SECTION OF H^-. Adelman, S. A. (Harvard Univ., Cambridge, MA). J. Phys., B (London); 6: No. 10, 1986-1991(Oct 1973).

The differential and total cross sections for two-photon detachment of H^- are computed analytically within the asymptotic model for both linearly and circularly polarized light. The total cross section for unit flux is of the order 10^{-40} cm^3. The differential cross section for linearly polarized light is nearly isotropic near the two-photon absorption threshold but is sharply peaked along the polarization direction just below the threshold for one-photon detachment. The circular polarization efficiency is very small near the two-quantum threshold but is close to its theoretical maximum near the one-quantum threshold. (auth)

8668 EXPERIMENTAL DETERMINATION OF THE REPULSIVE POTENTIALS BETWEEN Li^+ IONS AND RARE-GAS ATOMS. Inouye, H.; Kita, S. (Tohoku Univ., Sendai). J. Phys. Soc. Jap.; 34: No. 6, 1588-1592(Jun 1973).

Integral elastic scattering cross sections of Li^+ ions scattered through effective laboratory angles greater than 5×10^{-3} rad in collision with Ne, Ar, and Kr atoms at room temperatures were measured in the ion energy range of 500 to 4000 eV. The repulsive potentials derived from the cross sections are represented by the following analytical formulas: Li^+-Ne: $V(r) = 1620 \exp(-5.30r)$ $1.0 < r < 1.5$, -Ar: $V(r) = 1750 \exp(-424r)$ $1.3 < r < 1.9$, and -Kr: $V(r) = 2210 \exp(-4.08r)$ $1.4 < r < 2.0$, where V(r) and r are in units of eV and Å, respectively. Repulsive potentials for the Ne-Ne, Ar-Ar, Kr-Kr, and Li^+-Li^+ systems were also deduced by applying the combining rule to the potentials for the Li^+-rare-gas systems. The results are in reasonable agreement with those published by other workers in the potential range between 10 eV and several tenths of an eV. (auth)

8669 ELASTIC SCATTERING OF 100- AND 200-keV POSITRONS BY SELENIUM AND BISMUTH. Kobayashi, T.; Shimizu, S. (Kyoto Univ.). Bull. Inst. Chem. Res., Kyoto Univ.; 50: No. 5, 488-498(Sep 1972).

The differential cross sections for elastic scattering of positrons in ^{34}Se and ^{83}Bi targets were measured at 30, 40, 60 and 85° for energies of 100 and 200 keV. Positron beams of these energies were obtained by the use of a sector-type double-focusing β-ray spectrometer mounted with a ^{22}Na source. Scattered positrons were measured by semi-conductor (silicon) detectors in a scattering chamber. The experimental results were compared with the theoretical values calculated by the Mott phase-shift method. Though the experimental cross sections were, on the whole, in agreement with the theoretical values, the experimental cross sections tend to be lower than the theoretical ones, especially in the case of 100-keV positron scattering in Bi targets. This phenomenon was considered to be due to the effect of local distortion of the electron cloud by the incident particle. (auth)

8670 TRANSITIONS AMONG THE $3p^2P$ STATES OF SODIUM INDUCED BY COLLISIONS WITH HELIUM. Reid, R. H. G. (Harvard Coll. Observatory, Cambridge, MA). J. Phys., B (London); 6: No. 10, 2018-2039(Oct 1973).

Cross sections for transitions among the $Na(3p^2P_{jm})$ states induced by $He(^1S)$ collisions are calculated for impact energies $E \leq 0.07$ eV by a close coupled wave treatment with an orientation-dependent interaction. The cross section $\sigma(j'm';jm)$ for the transition in which the total angular momentum j and its projection m are changed to j′ and m′, the cross section $\sigma(j';j)$ for $j \rightarrow j'$ transition in which an average over m and a summation over m′ are taken, the angular distribution $d\sigma(j'j|\theta)/d\theta$, the multipole relaxation cross sections, and the polarization transfer cross section σ_{pt} are evaluated. The agreement with experiment is good for $\sigma(3/2,1/2)$, less so far σ_{pt}. The results of Lewis and McNamara (Phys. Rev.; A5: 2643-51 (1972)) differ by 20%. The error implicit in impact parameter calculations exceeds 40% for collision energies less than 0.02 eV and the good agreement with the results of Masnou-Seeuws (J. Phys. B. Atom. Molec. Phys.; 3: 1437-47 (1970)) is fortuitous. Transitions $jm \rightarrow j-m$ are allowed. The cross section $\sigma(jm';jm)$ exhibits interference at low energies. The undulations in some of the cross sections $\sigma(j'm';jm)$ arise from the component $B(j'j;2)$ in the Grawert coupling scheme (Z. Phys.; 225: 283-92 (1969)). For energies greater than 0.008 eV the $j = 1/2$ depolarization cross section is mainly due to $j = 1/2 \rightarrow 1/2$ transitions and almost constant. The angular distribution $d\sigma(31/22|\theta)/d\theta$ shows interference between three wave trains. The cross section $\sigma(3/2,1/2)$ and $d\sigma(31/22|\theta)/d\theta$ are evaluated for several interactions. The relation between $\sigma(3/2,1/2)$ and the interaction is discussed. There is no impact parameter below which the transition probability can be taken as a prescribed constant. Lennard-Jones interactions underestimate $\sigma(3/2,1/2)$ at energies near 0.04 eV. If the interaction has an exponentially repulsive core, then the long range forces have little influence on either $\sigma(3/2,1/2)$ or $d\sigma(31/22|\theta)/d\theta$ at 0.04 eV. For a Lennard-Jones interaction, $\sigma(3/2, 1/2)$ has resonance structure which is related to shape resonances in the uncoupled elastic channels. (auth)

8671 ELASTIC SCATTERING BY SPHERICALLY-SYMMETRIC r^{-2} AND r^{-3} POTENTIALS. Ganas, P. S. (California State Univ., Los Angeles). Physica; 68: No. 1, 164-170(15 Aug 1973).

The phase shifts due to scattering from spherically-symmetric r^{-2} and r^{-3} potentials, as obtained from Schroedinger theory on the one hand, and the Born approximation on the other are examined. (auth)

8672 ELASTIC SCATTERING OF POSITRONS BY HYDROGEN ATOMS. Moussa, A. H. (Kuwait Univ.); Abdel-Raouf, M. A.

Physica; 68: No. 1, 195-202(15 Aug 1973).

The Kohn variational method is applied to the s-wave elastic scattering of positrons by hydrogen atoms. The trial wave function is taken to include a function allowing for the effect of virtual positronium as well as correlation functions. The size of the resulting phase shifts indicates that the proposed virtual positronium function allows for the polarization of the atom, and is believed to be equivalent to several correlation functions. (auth)

8673 FORMATION OF H(2p) AND H(2s) ATOMS IN COLLISIONS OF 2 TO 26 keV PROTONS WITH HYDROGEN ATOMS. Morgan, T. J.; Geddes, J.; Gilbody, H. B. (Queen's Univ., Belfast). J. Phys., B (London); 6: No. 10, 2118-2138(Oct 1973).

A modulated crossed-beam technique was used to determine cross sections for the four reactions: $H^+ + H(1s) \rightarrow H(2s \text{ or } 2p) + H^+$ (electron capture) and $H^+ + H(1s) \rightarrow H^+ + H(2s \text{ or } 2p)$ (excitation) within the energy range 2.3 to 26 keV. Results were based on measurements, using a Doppler-shift identification technique, of the Lyman α radiation emitted from the beam intersection region both in the absence and in the presence of an electric field. While cross sections for excitation of the 2s state have not been reported previously, cross sections for capture into the 2s state agree well with those measured by Bayfield (Phys. Rev.; 185: 105-12 (1969)) using a furnace target technique. The H(2p) formation cross sections are also shown to be in reasonable accord with values based on the crossed-beam measurements of Stebbings et al (Phys. Rev.; 138A: 1312-16 (1965)). The cross sections for all four reactions are in good general agreement over the entire energy range with the coupled-state calculations of Cheshire et al (J. Phys. B. Atom. Molec. Phys.; 3: 813-32 (1970)) incorporating a pseudo-state expansion. Below 7 keV the data are well represented by a molecular treatment of the collision. As part of a check on the experimental procedure, measurements were also carried out using H_2 and Ar targets including, in the latter case, studies of the polarization of the Lyman α radiation. (auth)

8674 DISSOCIATIVE IONIZATION BY ELECTRON IMPACT. II. N^+ and N^{++} from N_2. Crowe, A.; McConkey, J. W. (Univ. of Windsor, Ont.). J. Phys., B (London); 6: No. 10, 2108-2117 (Oct 1973).

The angular distributions of both N^+ and N^{++} produced in the electron impact dissociation of N_2 are presented for incident electron energies up to 300 eV. The N^+ distributions show only a small anisotropy and are in excellent agreement with a previous measurement. Angular distributions for the N^{++} ion are also found to show little anisotropy. Absolute ionization efficiency curves for N_2^+, N^+ and N^{++} from their respective thresholds to 300 eV are presented and comparisons are made with the results of other workers where available. (auth)

8675 DISSOCIATIVE IONIZATION BY ELECTRON IMPACT. I. Protons from H_2. Crowe, A.; McConkey, J. W. (Univ. of Windsor, Ont.). J. Phys., B (London); 6: No. 10, 2088-2107 (Oct 1973).

A new apparatus designed to investigate various aspects of the electron impact dissociative ionization process is described in detail. It is shown that the angular distributions obtained for protons from the $^2\Sigma_u^+$ state of H_2^+ are consistent with theoretical arguments and confirm the results of previous measurements. The first angular distribution of protons from the $^2\Sigma_g^+$ state of H_2^+ is also reported. Absolute cross sections for the production of protons from both the $^2\Sigma_g^+$ and $^2\Sigma_u^+$ state of H_2^+ at electron energies close to the respective thresholds are also presented. The ratio H^+/H_2^+ is measured as a function of incident electron energy for ions originating from the $^2\Sigma_g^+$ state. It is shown that the result is consistent with a recently measured photon impact ratio when account is taken of the different threshold laws for electron and photon ionization. (auth)

8676 ELASTIC AND INELASTIC SCATTERING OF Li^+ IONS BY RARE GASES (Ne, Ar, Kr, Xe). Barat, M. (Paris Univ., Orsay, France); Dhuicq, D.; Francois, R.; Sidis, V. J. Phys., B (London); 6: No. 10, 2072-2087(Oct 1973).

Elastic and inelastic differential measurements in Li^+-rare gases collisions were performed in the keV energy range. On the other hand ab initio calculations were carried out on some potential energy curves of $(Li\text{-}Ne)^+$ and $(Li\text{-}Ar)^+$. The experimental data are examined in the framework of the quasi-molecular aspect of atomic collisions leading to a discussion of the validity of the "electron promotion model" (Fano, Lichten Phys. Rev. Lett.; 14: 627-9 (1965)) for outer shell excitation mechanisms. (auth)

8677 MANY-BODY THEORY OF THE GENERALIZED OPTICAL POTENTIAL FOR ELECTRON–ATOM (MOLECULE) INELASTIC SCATTERING. Csanak, G.; Taylor, H. S.; Tripathy, D. N. (Univ. of Southern California, Los Angeles). J. Phys., B (London); 6: No. 10, 2040-2054(Oct 1973).

Using the Martin-Schwinger (Phys. Rev.; 115: 1342-73 (1959)) variational technique a new theory is obtained for electron-atom (molecule) inelastic scattering. This theory constitutes a higher order approximation than the generalized random phase approximation (GRPA) elastic theory. In analogy with elastic scattering, an equivalent optical potential, named, the transition potential, is introduced for inelastic scattering. In the GRPA this transition potential is of the first-order static-exchange type. The present theory adds three new effects to the GRPA transition potential. One of them represents the screening of the first-order exchange term, another one the transition polarization effect and the third the effect of the final state field. In contrast to close-coupled or Kohn-type variational theories, the present theory has the advantage of decoupling the scattering channels through the use of the energy-dependent transition potential. As a consequence, this theory will be particularly useful for problems when the number of open channels are large. (auth)

8678 REPULSIVE POTENTIAL OF THE INTERACTION BETWEEN N_2 MOLECULE AND Ar ATOM. Gaidaenko, V. I. (Moscow Physical-Technical Inst.). Dokl. Akad. Nauk SSSR; 211: No. 1, 67-68(1 Jul 1973). (In Russian).

Parameters calculated for the interaction of the two-atom nitrogen and carbon monoxide molecules with the single-atom argon molecule are presented. The calculations were based on the statistical theory of the atom using the Thomas-Fermi-Dirac function both with and without consideration of the correlation correction. (auth)

8679 IMPULSIVE INELASTIC SCATTERING OF $O^+(^4S)$ BY ISOTOPIC HYDROGEN MOLECULES. Gillen, K. T.; Mahan, B. H.; Winn, J. S. (Univ. of California, Berkeley). Chem. Phys. Lett.; 22: No. 2, 344-347(1 Oct 1973).

Experimental evidence is presented that at relative energies above 10 eV the nonreactive inelastic scattering of O^+ by H_2, D_2, and HD arises from impulsive elastic scattering of O^+ by individual H or D atoms. The relation of this impulsive nonreactive scattering to the reactive scattering from these systems is briefly discussed. (auth)

8680 HIGH-RESOLUTION Ne KLL AUGER SPECTRA PRODUCED BY H^+ AND He^+ BOMBARDMENT. Matthews, D. L.; Johnson, B. M.; Mackey, J. J.; Moore, C. F. (Univ. of Texas, Austin). Phys. Lett., 45A: No. 6, 447-448(5 Nov 1973).

Ne KLL Auger satellite lines are measured with an energy resolution of 0.02% FWHM. The relative intensities of initial 2p vacancy satellite lines are observed to be four times larger with He^+ than with H^+ bombardment. The He^+ beam also produces new satellite lines which are assigned to double initial 2p vacancies. (auth)

8681 MOLECULAR-ORBITAL THEORETICAL CLASSIFICATION OF REACTIONS OF SINGLET GROUND-STATE MOLECULES. Yamaguchi, K. (Osaka Univ.); Fueno, T.; Fukutome, H. Chem. Phys. Lett.; 22: No. 3, 461-465(15 Oct 1973).

The reaction mechanisms of molecular systems in the ground singlet state are discriminated with the triplet stability–instability criterion of the restricted Hartree–Fock (RHF) solution for the entire system and with the phase continuity criterion of the highest occupied orbital involved. The criteria used are discussed in relation to the outcomes from the configuration-interaction approach. (auth)

8682 RESONANCE EFFECTS IN INELASTIC COLLISIONS BETWEEN SLOW ELECTRONS AND CADMIUM OR ZINC ATOMS. Shpenik, O. B.; Zapesochnyi, I. P.; Sovter, V. V.; Kontrosh, E. E.; Zavilopulo, A. N. (Uzhgorod State Univ., USSR). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1797-1805(Nov 1973). (In Russian).

Precise investigations of the cross sections for excitation of the lower levels of Zn and Cd by monoenergetic electrons are carried out by a spectroscopic technique. A number of peaks of a resonant nature which may be due to cascade transitions or to negative ion decay are detected on the excitation curves. Deep (antiresonances) are observed on the excitation function of the $Cd5^1P_1$ level. With respect to energy they coincide with the resonances of the excitation functions of the $^3S_1$ levels. The single-level Breit–Wigner formula is employed for describing the near-threshold peaks of the excitation functions of the deepest $^3S_1$ levels in Zn and Cd. A new mechanism for level population in electron–atom collisions is proposed. (auth)

8683 IMPORTANCE OF LONG-RANGE FORCES AND SHORT-RANGE FORCES IN ELECTRON SCATTERING: ELASTIC SCATTERING BY N_2 AT 10 AND 30 eV. Brandt, M. A.; Truhlar, D. G. (Univ. of Minnesota, Minneapolis). Chem. Phys. Lett.; 23: No. 1, 48-52(1 Nov 1973).

Polarized Born and fixed-nuclei approximation (sudden approximation) quantum mechanical calculations of the sum of the elastic scattering and rotational excitation differential cross sections are presented, compared to published experimental values, and interpreted in terms of the forces. (auth)

8684 DIFFERENTIAL SCATTERING WITH ELECTRON CAPTURE IN THE TWO-FIXED-CENTER APPROXIMATION. Gryzinski, M. (Inst. of Nuclear Research, Otwocka, Poland). Phys. Lett.;46A: No. 1, 5-6(19 Nov 1973)..

It is shown that oscillations of electron capture probability in H^+-H low energy scattering can be explained on the ground of the classical three-body problem. (auth)

8685 GIANT GLORY EFFECT IN ATOMIC COLLISIONS. Demkov, Yu. N.; Los, J. (Leningrad State Univ.). Phys. Lett.; 46A: No. 1, 13-14(19 Nov 1973).

The effect of total backscattering in elastic collisions from cut-off Coulomb potentials is discussed. (auth)

8686 CROSS SECTIONS FOR Ne K-X-RAY PRODUCTION IN Ne^+-Ne COLLISIONS (100 keV TO 1.2 MeV). Schartner, K. H.; Schaefer, H.; Hippler, R. (Univ., Giessen, Ger.). Phys. Lett.; 46A: No. 1, 31-32(19 Nov 1973).

Absolute cross sections for Ne-K x-ray emission in collisions of Ne^+ ions with Ne atoms were measured at energies from 100 keV to 1.2 MeV. The cross section rises approximately linear with energy. The results are in satisfactory agreement with respective measurements at lower energies. (auth)

8687 K-SHELL IONIZATION BY EXTREME RELATIVISTIC ELECTRONS. Dangerfield, G. R. (Univ. of Melbourne). Phys. Lett.; 46A: No. 1, 19-20(19 Nov 1973).

The results of a calculation of the electron K-ionization cross section which considers the influence of the atoms adjacent to the target atom are presented. The predicted energy dependence differs from that observed by Middleman, Ford, and Hofstadter between 150 and 900 MeV. (auth)

8688 R-MATRIX APPROACH TO COLLINEAR INELASTIC COLLISIONS: RESONANCES. Heller, E. J. (Harvard Univ., Cambridge, MA). Chem. Phys. Lett.; 23: No. 1, 102-105(1 Nov 1973).

The quantum mechanical collinear atom–diatom collision problem is treated via a discrete expansion of the wave function in terms of uncoupled, distorted wave states, using the Wigner–Eisenbud R-matrix formalism. Previously unreported narrow Feshbach resonances, which reduce the inelastic transition probability, are easily found and examined. Off resonant transition probabilities are in agreement with the work of Diestler and Feuer using the same model. (auth)

8689 RESONANCE, AUGER, AND AUTOIONIZATION PROCESSES INVOLVING $He^+(2s)$ AND He^{++} NEAR SOLID SURFACES. Hagstrum, H. D.; Becker, G. E. (Bell Telephone Labs., Murray Hill, NJ). Phys. Rev., B; 8: No. 1, 107-121 (1 Jul 1973).

Electronic transition processes of a resonance and of an Auger type which can occur at a solid surface were studied for incident metastably excited $He^+(2s)$ and doubly charged He^{++} ions. Atomically clean Ni(100) and Ni(110) surfaces were used as well as those surfaces with a c(2 × 2)Se structure adsorbed upon them. It is shown that the principal process of deexcitation of the $He^+(2s)$ ion involves resonance tunneling to a doubly excited He^{0**} state of the He atom followed by its autoionization to the ground-state ion $He^+(1s)$ with the ejection of a fast electron. Autoionized electrons produced near the surface are 0.7 to 0.9 eV faster than those produced in free space. The change in the work function from 4.7 eV for Ni(110) to 5.1 eV for Ni(100) reduces the number of peaks of ejected electrons from two to one. These experimental facts are shown to be self-consistent and to arise from energy-level shifts near the solid surface. Several aspects of the kinetics of the two-stage processes in competition with possible single-stage processes are discussed. It is also demonstrated that He^{++} is first resonance neutralized by one electronic charge to the $He^+(2s)$ state, which process is then followed, closer to the surface, by those observed for incident $He^+(2s)$. (auth)

Atomic Theory

Refer also to abstracts 9065 and 9091.

8690 (JINR-P4-7296) ISOMERIC SHIFT AND NEUTRON RESONANCES. Ignatovich, V. K.; Ostanevich, Yu. M.; Cher, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The possibility of measuring the isomer shift of low-lying neutron resonances is shown. The nuclear properties which are accessible for investigation by using this measurement are discussed. The influence of the temperature and the characteristics of the material on the neutron resonance position is considered. (1 figure) (auth)

8691 MONTE CARLO TRAJECTORY CALCULATIONS OF ATOMIC AND MOLECULAR EXCITATION IN THERMAL SYSTEMS. Keck, J. C. (Massachusetts Inst. of Tech., Cambridge). Advan. At. Mol. Phys.; 8: 39-69(1972).

A systematic discussion of Monte Carlo methods for studying thermal excitation and dissociation in atomic and molecular systems is presented, and a review is given of the results that have been obtained. Thermal excitation and dissociation processes described by means of master equations and equivalent diffusion equations, Monte Carlo techniques for obtaining the transition kernels and transport coefficients required for solution of these equations, and numerical results obtained for these systems are discussed. (JFP)

8692 AUGER EFFECT. Burhop, E. H. S. (University Coll., London); Asaad, W. N. Advan. At. Mol. Phys.; 8: 163-284 (1972).

A review is given of the Auger effect theory and spectrum and the fluorescence yield. (JFP)

8693 QUANTUM LOGIC AXIOMS AND THE PROPOSITION-STATE STRUCTURE. Gallone, F.; Zecca, A. (Univ., Milan). Int. J. Theor. Phys.; 8: No. 1, 51-63(1973).

A possible picture of the axiomatic basis of quantum mechanics is drawn and the set of propositions of the quantum logic approach to quantum mechanics is shown to be a complete, orthocomplemented and weakly modular lattice. A condition that the set of propositions be atomic is found, in which the notion of "characteristic state" is involved. This scheme is compared with the usual Hilbert one, and in a Hilbert picture in which discrete superselection rules can be present also, the characteristic states are shown to be the pure states. (auth)

8694 ELECTRON WAVE FUNCTIONS IN OVER-CRITICAL ELECTROSTATIC POTENTIALS. Mueller, B.; Rafelski, J.; Greiner, W. (Univ., Frankfurt am Main). Nuovo Cim., 18A: No. 3, 551-573(1 Dec 1973).

The mathematical properties of the solutions of the Dirac equation in over-critical external potentials are investigated. The $1/r$ Coulomb potential is treated as the limit $R \to 0$ of cut-off Coulomb potentials (R is the cut-off parameter). The results are interpreted in terms of quantum electrodynamics. A number of new physical phenomena occur in quantum electrodynamics of strong fields. One of the most interesting ones is the autoionization of positrons (energyless creation of electron-positron pairs) in over-critical external fields. (auth)

8695 STARK EFFECT IN HIGH FREQUENCY FIELDS. Bonch-Bruevich, A. M.; Khodovoi, V. A.; Przhibel'skii, S. G. pp 255-277 of Conference on the Interaction of Electrons With Strong Electromagnetic Field. Budapest; Central Research Inst. for Physics (1972).

From conference on interaction of electrons with strong electromagnetic field; Balatonfuered, Hungary (11 Sep 1972). See CONF-720976-.

The treatment covers the experimental investigation of the Stark effect in high frequency fields. The results support the theory of this phenomenon which is based on the assumption of small perturbations. (JFP)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

8696 CONSTRUCTION OF POMERON STATES IN THE ZERO-WIDTH APPROXIMATION. Ramond, P. (CERN, Geneva). Phys. Lett.; 47B: No. 2, 152-154(29 Oct 1973).

A kinematical construction is presented for the Pomeron in models of relativistic composite particles in the zero-width approximation. (auth)

8697 SOME PROPERTIES OF ALIGNED MHD FLOWS. Chandna, O. P.; Nath, V. I. (Windsor Univ., Ont.). Jap. J. Appl. Phys.; 11: No. 6, 889-892(Jun 1972).

The flow considered is steady; the magnetic lines are everywhere parallel to the streamlines and the fluid is infinitely conducting and nonviscous. If the density is constant along each individual streamline, then any flow field satisfying the flow equations is a member of an infinite group of flow fields sharing the same streamlines. If one of the four scalar quantities, the speed V, the density p, the pressure p and the speed of sound c, is constant along each streamline in a plane flow then the other three, together with the vorticity ω, are also constant along each streamline; the streamlines are either concentric circles or parallel straight lines. Converses are also true. (auth)

8698 MPD ANNULAR DUCT FLOW IN A CROSSED-FIELD DEVICE FOR ARBITRARY VALUES OF THE HALL PARAMETER. Robert, K. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt eV, Porz-Wahn, Ger.). Z. Naturforsch.; 28A: No. 7, 1108-1113(1973). (In German).

The steady, supersonic, barotropic, and inviscid flow of a rarefied gas plasma through an axisymmetric crossed-field device (imposed axial electric field and radial magnetic induction) is being analyzed, for arbitrary values of the Hall parameter. A previously developed perturbation method is used to obtain closed form solutions for the electric current density, flow velocity, and mass density within the annular duct. Conditions for optimal values of the Hall parameter are given. (GE)

8699 MAGNETOHYDRODYNAMICAL STEADY ALIGNED FLOW PAST AN OBLIQUE FLAT PLATE AT A HIGH REYNOLDS NUMBER. Suwa, S. (Defence Academy, Yokosuka, Japan). J. Phys. Soc. Jap.; 34: No. 6, 1649-1658(Jun 1973).

The flow of an electrically conducting viscous fluid past an insulated flat plate at a small incidence, θ, is dealt with by the linearized approximation. The behavior of the flow at large values of viscous Reynolds number, R, magnetic Reynolds number, R_m, and pressure number, S, is studied. Four characteristic types of flow are shown. In the first case: $1 \ll R \leqq O(1/\sin\theta)$ and $\kappa_1 = (1 + R_m/R) - [(1 - R_m/R)^2 + 4R_mS/R]^{1/2} > 0$, the flow field reduces to the conventional potential flow satisfying the Kutta–Joukowski condition. In the second case: $1 \ll R \leqq O(1/\sin\theta)$ and $\kappa_1 < 0$, the flow field becomes the potential flow satisfying the MHD Kutta–Joukowski condition. In the third case $O(1/\sin^2\theta) \ll R$ and $\kappa_1 > 0$, the flow field consists of a potential field and a wide wake spreading downstream, where the flow is rotational and the velocity almost vanishes. In the last case: $O(1/\sin^2\theta) \ll R$ and $\kappa_1 < 0$, the flow field consists of two wide wakes spreading both up- and downstream. (auth)

PHYSICS (HIGH-ENERGY)

8700 FUNDAMENTAL INTERACTIONS IN PHYSICS. Conference Held in Coral Gables, Florida, January 22–26, 1973. Perlmutter, A. (ed.). Studies in the Natural Sciences. Volume 2. New York; Plenum Publishing Corporation (1973). 408p. (CONF-730124-). $25.00.

Twenty papers are included which cover the following topics: astrophysics, atomic and molecular physics, fundamental theories of gravitation, of electromagnetism, and of hadrons, gauge theories of weak and electromagnetic interactions, high energy physics, liquid helium physics, and theoretical biology. Separate abstracts were prepared for eighteen papers. One paper was previously abstracted for NSA and appeared as 28:15634. The paper on theoretical biology is not within the subject scope of NSA. (LBS)

For abstracts of individual lectures see: 8509, 8626, 8627, 8648, 8661, 8662, 8702, 8743, 8779, 8780, 8795, 8815, 8855, 8856, 8874, 9258, 9259, and 9278.

8701 PROCEEDINGS OF THE SEVENTH FINNISH SUMMER SCHOOL IN PHYSICS, LOMA-KOLI, FINLAND, JUNE 26–July 7, 1972. Pellinen, R. (ed.). Helsinki; University of Helsinki (1972). 454p. (CONF-720693-).

From seventh Finnish summer school in physics, modern developments in hadron physics; Loma-Koli, Finland (26 Jun 1972).

Ten lectures are included; a separate abstract is prepared for each lecture. (LBS)

For abstracts of individual lectures see: 8708, 8730, 8758–8762, 8800, 8809, and 9286.

Particle Interactions and Properties (Experimental)

Refer also to abstracts 8748–8751.

8702 INITIAL EXPERIMENTS AT NAL. Wilson, R. R. (National Accelerator Lab., Batavia, IL). pp 97-108 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

A general survey is given of the experimental areas of the NAL and some of the experimental work expected to be carried out. (LBS)

Electromagnetic

Refer also to abstract 8762.

8703 (JINR-P3-7377) MAGNETIC SYSTEM OF THE ASSEMBLY FOR MEASUREMENT OF THE ELECTRIC DIPOLE NEUTRON MOMENT ON UCN. Taran, Yu. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Because of the need of a precise measurement of the electric dipole moment (EDM) of the neutron ($\pm 10^{-25}$ cm), there was chosen and calculated the magnetic system of an assembly for an EDM search with the help of ultracold neutrons. The system consists of a six-layer magnetic screen with an attenuation coefficient of 1500 and a short solenoid with two correcting coils providing a field homogeneity in the storage chamber volume not less than 0.1%. Simulation of the magnetic screen is performed on a scale of 1 : 4, and the residual field is obtained to be $(3 \pm 5) \times 10^{-6}$ Oe, the volume being $20 \times 7 \times 7$ cm^3 and the mean-square inhomogeneity being 0.5×10^{-6} Oe. (9 figures) (auth)

8704 (KFK-EXT-3/73-4) NEUTRAL DECAY MODES OF THE η-MESON AND THE DECAY $\eta' \rightarrow \gamma\gamma$. Sigurdsson, G. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Experimentelle Kernphysik). Aug 1973. 79p. (In German). Dep. NTIS (U. S. Sales Only) $6.00.

Thesis. Submitted to Karlsruhe Univ. (West Germany).

The branching ratios of the $\eta(549)$ neutral decay modes and the η'-decay into two γ-quanta were measured. The mesons were produced in the reaction $\pi^- p \rightarrow X^0 n$ at 3.8 GeV/c pion momentum in a liquid hydrogen target. The target interaction point and neutron momentum and angle were measured, thereby allowing the calculation of the X^0-mass, through which events with $X^0 = \eta$ and $X^0 = \eta'$ were selected. The decay γ-quanta were detected in an optical spark chamber, measuring their momentum and direction with respect to the incoming beam. We obtain the following η-branching ratios: $R_1 = (\eta \rightarrow \gamma\gamma)/(\eta \rightarrow \text{neutrals}) = (59.4 \pm 4.7)\%$; $R_2 = (\eta \rightarrow \pi^0\gamma\gamma)/(\eta \rightarrow \text{neutrals}) = (0.2 \pm 2.7)\%$, $R_3 = (\eta \rightarrow 3\pi^0)/(\eta \rightarrow \text{neutrals}) = (40.4 \pm 6.5)\%$, and the branching ratio of η' into $\gamma\gamma$: $R = (\eta' \rightarrow \gamma\gamma)/(\eta' \rightarrow \text{all}) = (3.7 \pm 1.3)\%$. The results will be discussed. (auth) (GE)

8705 (LNF-73/28) WIDE ANGLE ELECTRON–POSITRON BREMSSTRAHLUNG AT ADONE. A New Limit for the Existence of a Heavy Electron. Bacci, C.; Baldini Celio, R.; Capon, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 6 Jun 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

The cross section for the reaction $e^+ + e^- \rightarrow e^+ + e^- + \gamma$ was measured at the Adone storage ring. The results, in agreement with the QED predictions, establish a new limit for the mass and the coupling constant $e^* e\gamma$ of a heavy electron e^*. (auth)

8706 (LNF-73/29) RESULTS OF AN EXPERIMENT TO TEST FOR AN I = 2 TERM IN THE ELECTROMAGNETIC CURRENT. Di Capua, E.; Fiorentino, E.; Palmonari, F.; Pocci, V.; Reale, A.; Satta, L.; Severi, M.; Tau, L.; Ubaldini, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 6 Jun 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

The ratio r between the differential cross sections for the reactions $\gamma + d \rightarrow \pi^0 + n(p) + p(n)$ at 270 to 370 MeV was measured to be 1.08 ± 0.11 with a lower limit of 0.93 with 90% confidence level. Evidence is thus given against a large isotensor term. Under the hypothesis that in the absence of any isotensor term the cross sections of these processes would be equal, an upper limit of the I = 2 term of about 3% is given. (JFP)

8707 (LNF-73/50) FURTHER RESULTS ON REACTIONS $e^+e^- \rightarrow e^+e^-e^+e^-$ AND $e^+e^- \rightarrow e^+e^-\mu^+\mu^-$ WITH ADONE STORAGE RING AT 1400 TO 1500 MeV. Bacci, C.; Baldini-Celio, R.; Capon, G. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 23 Aug 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The number of observed and expected events and the total luminosity are found for the interactions $e^+ + e^- \rightarrow 2e^+ + 2e^-$ and $e^+ + e^- \rightarrow e^+ + e^- + \mu^+ + \mu^-$ at 1400 to 1500 MeV in colliding beams. (JFP)

8708 EXPERIMENTS PERFORMED AT ADONE STORAGE RING AND RESULTS ON THE MULTIHADRONIC PRODUCTION. Spinetti, M. (CNEN, Frascati, Italy). pp 359-380 of Proceedings of the Seventh Finnish Summer School in Physics, Loma-Koli, Finland, June 26–July 7, 1972. Pellinen, R. (ed.). Helsinki; Univ. of Helsinki (1972).

From seventh Finnish summer school in physics, modern developments in hadron physics; Loma-Koli, Finland (26 Jun 1972). See CONF-720693-.

Five groups of e^+e^- experiments in the energy range 1.2 to 2.4 GeV are summarized and results on cross sections for multihadron production are presented. (LBS)

8709 STRUCTURE FUNCTIONS OF DEEPLY INELASTIC e–p SCATTERING. Bilen'kaya, S. I.; Bilen'kii, S. M.; Kazarinov, Yu. M.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1745-1755(Nov 1973). (In Russian).

The results of an analysis of all available data on deeply inelastic e–p scattering are presented. Various parametrizations of the νW_2 and $R = \sigma_S/\sigma_T$ functions are considered. The region of scale invariance for the function νW_2 is determined. It is shown that the experimental data can be satisfactorily described by various parametrizations of R. (auth)

8710 ELECTROMAGNETIC EMISSION FROM A MODULATED ELECTRON BEAM. Katyshev, E. G.; Panasyuk, V. S.; Pankratov, S. G.; Romanovskii, V. F.; Samoshenkov, Yu. K.; Sokolov, A. A.; Spektor, Ya. M.; Stepanov, B. M. Sov. Phys. Tech. Phys. (Engl. Transl.); 17: No. 11, 1905(May 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 11, 2446(Nov 1972).

A block diagram and the experimental parameters for examining the electromagnetic emission of a velocity-modulated electron beam, together with the results are presented. The coherent emission from a velocity-modulated electron beam was measured. (JFP)

Weak

8711 (JINR-P2-7455) $\nu_e e(\bar{\nu}_e e)$ SCATTERING IN NONLOCAL THEORY WEAK INTERACTIONS. Zibol'd, K.; Malyshkin,

V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The differential and total cross sections for the $\nu_e e(\bar{\nu}_e e)$-scattering in the framework of nonlocal theory of weak interactions are calculated. A comparison with experimental data is made. (auth)

8712 EXPERIMENTAL STUDY OF THE FORM FACTOR IN THE DECAY $K^+ \to \pi^0 e^+ \nu$. Braun, H. (Technische Hochschule, Aachen); Cornelssen, M.; Martyn, H. U. Phys. Lett.; 47B: No. 2, 185-188(29 Oct 1973).

The q^2 variation of the form factor $f_+(q^2)$ in the decay $K^+ \to \pi^0 e^+ \nu$ has been studied using a sample of events detected in the CERN 1.1 m^3 heavy-liquid bubble chamber. The data are consistent with a linear development $f_+(q^2) = f_+(0)\,(1 + \lambda_+ q/m_\pi^2)$ with $\lambda_+ = 0.027 \pm 0.008$. (auth)

8713 EXPERIMENTAL STUDY OF THE $K^+ \to \pi^0 \mu^+ \nu$ DECAY DALITZ PLOT. Braun, H. (Technische Hochschule, Aachen); Cornelssen, M.; Martyn, H. U. Phys. Lett.; 47B: No. 2, 182-184(29 Oct 1973).

A sample of $K^+_{\mu 3}$ events, detected in the CERN 1.1 m^3 heavy-liquid bubble chamber, was used to investigate the q^2 dependence of the form factors, giving $\xi(0) = -1.1 \pm 1.0$ and $\xi(6.6\ m_\pi^2) = -0.34 \pm 0.20$, for $\lambda_+ = 0.027$. A three parameter fit gives a value for $\lambda_+ = 0.025 \pm 0.017$ in good agreement with the preceding K_{e3} analysis. (auth)

Strong (Baryon-induced)

8714 (DESY-73/37) INVESTIGATION OF THE REACTION pp → pp + MESON RESONANCE AT 12 AND 24 GeV/c. Blobel, V.; Fesefeldt, H.; Franz, H.; Hellwig, B.; Idschok, U.; Kobe, P.; Lueers, D.; Moenkemeyer, D.; Schranke, W.; Schroeder, B.; Schwarz, B.; Soeding, P. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The reactions pp → pp + meson, where meson = η, ρ^0, ω, and f, were investigated at P_{inc} = 12 and 24 GeV/c. Cross sections, rapidity distributions, momentum transfer and decay angular distributions are presented. Upper limits on the cross sections for $S^*(1000)$ and Φ production are given. An attempt is made to determine the dominating pairs of exchanges in the production of these resonances. (auth)

8715 (FRNC-TH-404) STUDY OF THE COHERENT PRODUCTION OF 2, 3 AND 5 PION SYSTEMS USING 11.7 GeV/c π^+. Arnold, R. (Strasbourg-1 Univ., 67 (France)). 1972. 135p. (In French). Dep. NTIS (U. S. Sales Only) $8.75.

Thesis.

Coherent scattering on heavy nuclei (carbon, fluorine and bromine) of 11.7 GeV/c π^+ was studied by comparing the 3π systems observed in the production of $\pi^+\pi^+\pi^-$ and $\pi^+\pi^0\pi^0$ systems in the 11 GeV/c^2 region. A method is described for selecting groups of events abundant in coherent reactions (application of longitudinal phase space analysis). Values are given for the cross sections involved in coherent production for three pion channels. In addition, the upper limits for the cross sections corresponding to two and five pion channels are presented. The mass and angular distributions obtained for the three pion channels are discussed. The $\sigma(A_1 \to \rho^+\pi^0)/\sigma(A_1 \to \rho^0\pi^+)$ branching ratio is evaluated, and the cross section for A_1 interaction is estimated using the Glauber-Trefil model. (auth)

8716 (NP-19870) EXPERIMENTS WITH THE PROTON STORAGE RINGS AT CERN. Schmidt-Parzefall, W. (European Organization for Nuclear Research, Geneva (Switzerland)). 1972. 85p. (In German). Dep. NTIS (U. S. Sales Only) $6.25.

The storage rings at CERN were completed in 1971, offering a reaction energy which exceeded that of previous accelerators by almost one order of magnitude. Thus far, experiments revealed no new particles that might indicate the existence of a sub-elementary particle composition of the nuclei. The experimental work concerned exclusively strong interactions. Two-particle as well as multi-particle reactions were studied, and a search for quarks was conducted. (HBG)

8717 SOME SALIENT FEATURES OF ANTIPROTON-NUCLEON ANNIHILATIONS. Ma, Z. M.; Oh, B. Y.; Parker, D. L.; Smith, G. A. (Michigan State Univ., East Lansing). Phys. Lett.; 47B: No. 2, 177-181(29 Oct 1973).

Pion production data from $\bar{p}p$ and $\bar{p}n$ annihilation between 1.51 and 2.90 GeV/c were studied. The gross features of the data indicate that mechanisms for antiproton-nucleon annihilations are primarily of statistical nature. (auth)

8718 ANTINUCLEON PHYSICS. Peaslee, D. C. (Australian National Univ., Canberra). Aust. Phys.; 10: No. 9, 151-152(Sep 1973).

The production of anti-nucleons is described, and the problem of "momentum spread" is considered. An example is given where the resolution problem presents serious difficulties. New detection procedures and the search for $\bar{N}N$ resonances are described. (RL)

8719 LARGE-ANGLE INCLUSIVE PRODUCTION OF PROTONS, ANTIPROTONS AND KAONS, AND PARTICLE COMPOSITION AT THE CERN ISR. Alper, B. (CERN, Geneva); Boggild, H.; Booth, P. Phys. Lett.; 47B: No. 3, 275-280 (12 Nov 1973).

The production cross sections for protons, antiprotons and kaons in proton-proton collisions at center-of-mass energies $\sqrt{s}$ = 30.6 and 52.8 GeV at large angles and for the transverse momentum range $p_T < 1.2$ GeV/c for protons and antiprotons and $0.2 < p_T < 0.5$ GeV/c for kaons were measured. The charged particle composition is given in the range $0.2 < p_T < 0.5$ GeV/c and shows that the K^+ and p^+ components have doubled over this p_T-range. The ratio of positive to negative produced particles increases with p_T. (auth)

8720 OBSERVATIONS ON $\bar{p}p \to 3\pi^0, 2\pi^0\eta^0$ AT REST. Devons, S. (Columbia Univ., New York); Kozlowski, T.; Nemethy, P.; Shapiro, S.; Dris, M.; Horwitz, N.; Kalogeropoulos, T.; Skelly, J.; Smith, R.; Uto, H. Phys. Lett.; 47B: No. 3, 271-274 (12 Nov 1973).

Annihilations were observed of anti-protons stopped in liquid hydrogen yielding $3\pi^0$ and $3\pi^0\eta^0$, with a ratio $3\pi^0 : 2\pi^0\eta^0$ of 0.81 ± 0.08. The Dalitz plot of 2100 $3\pi^0$-events exhibits structures somewhat similar to those observed in $\bar{p}n \to 2\pi^-\pi^+$ (at rest); viz: depopulation at the center, enhancement at small $M^2(2\pi^0)$ and at about 2.35 (GeV/c^2)^2. (auth)

8721 MULTIPLICITY DISTRIBUTIONS IN PROTON-NUCLEUS COLLISIONS AT 67 AND 200 GeV. Babecki, J.; Czachowska, Z.; Furmanska, B.; Gicrula, J.; Holynski, R.; Jurak, A.; Krywdzinski, S.; Nowak, G.; Slezak, B.; Wolter, W. (Inst. of Nuclear Physics, Krakow). Phys. Lett.; 47B: No. 3, 268-270(12 Nov 1973).

New data concerning multiplicities in collisions of 67 and 200 GeV protons in emulsions are presented. Various parameters of multiplicity distributions in collisions of protons with nuclei of photographic emulsion at primary energies between a few and about 1000 GeV are compared with p-p collisions. (auth)

8722 NEUTRON-PROTON FINAL STATE INTERACTION IN P-D BREAKUP AT E_p = 585 MeV. Furic, M. (Rice Univ., Houston, TX); Fletcher, C. R.; Gabitzsch, N. D.; Mutchler, G. S.; Witten, T. R.; Phillips, G. C.; Hudomalj, J.; Lee, D. Y.; Gram, P. A. M.; Mayes, B. W.; Allred, J.; Goodman, C. Phys. Lett.; 47B: No. 3, 241-243(12 Nov 1973).

The first observation of the neutron-proton final-state interaction above E_p = 200 MeV is reported. The cross section is larger than expected from lower-energy data and pole graph considerations. (auth)

8723 MEASUREMENT OF INCLUSIVE NEUTRON SPECTRA FROM p-Be UP TO 24 GeV/c INCIDENT MOMENTUM. Engler, J.; Flauger, W.; Gibbard, B.; Moennig, F.; Pack, K.; Runge, K.; Schopper, H. (CERN, Geneva). Nucl. Phys., B64: No. 2, 173-193(1973).

Data are presented on inclusive neutron spectra produced in an internal Be target of the CERN PS, for incident proton momenta between 8 and 24 GeV/c at 0°, and for an incident proton momentum of 19 GeV/c at 50 mrad. (auth)

Strong (Meson-induced)

8724 (CERN-73-13) PION-DEUTERON ELASTIC SCATTERING AT INTERMEDIATE ENERGIES. Gabathuler, K. (European Organization for Nuclear Research, Geneva (Switzerland)). 1 Nov 1973. 44p. Dep. NTIS (U. S. Sales Only) $4.25.

The variation of the fixed-angle differential cross sections is determined for incident pion energies between 141 and 256 MeV for π^+ + d elastic scattering. The data are compared to a Brueckner model calculation including s- and p-wave single and double scattering. (JFP)

8725 (JINR-P1-7399) CHARACTERISTICS OF PROTONS EMITTED IN π^--Xe INTERACTIONS AT 3.5 GeV/c. Plyuta, Ya.; Strugal'skii, Z. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 16p. (In Russian). Dep.

NTIS (U. S. Sales Only) $3.00.

The results are presented of investigation of protons emitted in π^--Xe interactions at 3.5 GeV/c. The characteristics of the protons are given: emission frequency, mean kinetic energy, angular and momentum spectra. (auth)

8726 (JINR-P1-7543) STUDY OF CORRELATIONS IN PARTICLE PRODUCTION IN PION-NUCLEON INTERACTIONS AT p = 40 GeV/c. Abdurakhimov, A. U.; Angelov, N.; Vishnevskaya, K. P.; Grishin, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Results on several correlation phenomena in π^-p interactions at 40 GeV/c are reported. On the basis of ~ 2,000 events the dependence of transverse momenta of π^+-, π^--mesons on their longitudinal characteristics was studied. Two-particle transverse angle and rapidity distributions, correlation functions ($C(Y_1, Y_2)$ and $R(Y_1, Y_2)$) and associated multiplicity distributions for different types of π^-, π^+ combinations were also obtained. The results were compared with the phase-space calculations for the "average" reaction $\pi p \to 7\pi p$. It was found that: "sea-gull" effect holds; the transverse angle distributions within errors follow the phase space; the behavior of $C(Y_1, Y_2)$ shows strong positive correlations for π-meson pairs from the central region contrary to the phase space, the value of $C(Y_1, Y_2)$ is much greater for unlike π-meson pairs than for like ones; $R(Y_1, Y_2)$-function can be represented as $a \cdot \exp(-|Y_1-Y_2|/L)$ with $a = 0.65 \pm 0.07$ and $L = 1.8 \pm 0.2$ for unlike π-mesons and $a = 0.26 \pm 0.10$ for like ones. This result is in agreement with ISR and 200 GeV/c data, thus indicating the achievement of an early limiting behavior of the two-particle spectra in π^-N interactions at 40 geV/c. (auth)

8727 (LBL-2179) PROSPECTS FOR Y* EXPERIMENTS. Tripp, R. D. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 12 Oct 1973. Contract W-7405-eng-48. 13p. (CONF-730837-9). Dep. NTIS $3.00.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

It is noted that a major problem with Y* studies stems from difficulty in constructing low-momentum K^- beams of high intensity which could be employed in formation experiments using electronic means to accumulate high statistics. The status of bubble-chamber and electronic experiments is discussed. Some data are given on the established and conjectured Y* states. (LBS)

8728 (ORO-3509-10) ELEMENTARY PARTICLE PHYSICS AT THE FLORIDA STATE UNIVERSITY. Progress Report, November 1, 1972–October 31, 1973. (Florida State Univ., Tallahassee (USA)). Nov 1973. Contract AT(40-1)-3509. 23p. Dep. NTIS $3.25.

Research on strong interactions is summarized. A list of publications is included. (JFP)

8729 (RL-73-119) STUDY OF A AND R MEASUREMENTS IN K^+p SCATTERING. Fich, O.; Oades, G. C. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Oct 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

K^+p scattering at 1.9 GeV/c is considered, and it is shown that measurements of the R parameter with an accuracy of ±0.2 in the angular range $0.9 \geq \cos\theta \geq 0.4$ are sufficient to distinguish between the two types of phase shift solution and to decide whether the helicity flip amplitude is mainly real or mainly imaginary. (auth)

8730 INTERFERENCE BETWEEN ρ^+ PRODUCTION AND DIFFRACTIVE DISSOCIATION IN $\pi^+p \to p\pi^+\pi^0$ AT 3.6 GeV/c. MacNaughton, J. (Katoliche Univ., Neijmegen, Netherlands). pp 435-449 of Proceedings of the Seventh Finnish Summer School in Physics, Loma-Koli, Finland, June 26–July 7, 1972. Pellinen, R. (ed.). Helsinki; Univ. of Helsinki (1972).

From seventh Finnish summer school in physics, modern developments in hadron physics; Loma-Koli, Finland (26 Jun 1972). See CONF-720693-.

Evidence is obtained for a broad enhancement corresponding to low $p\pi^0$ mass from a Dalitz plot for the $p\pi^+\pi^0$ final state in the π^+p interaction at 3.6 GeV/c. The effect is examined in terms of a diffraction dissociation mechanism. From an inspection of the ρ-diffraction overlap region, it is suggested that the effect would be expected if there were interference between ρ^+ production and diffraction with a relative phase such as to produce destructive interference at low $\pi\pi$ masses and constructive interference at high $\pi\pi$ masses. The $\pi\pi$ mass spectra are examined and fitted to the ρ^+diffraction interference model. (LBS)

8731 REACTION $\pi^-p \to \pi^0n$ BETWEEN 1.0 AND 2.4 GeV/c. Nelson, J. E.; Chaffee, R. B.; Dahl, O. I.; Kenney, R. W.; Linscott, I. R.; Pripstein, M.; Risser, T. B.; Skuja, A.; Wahlig, M. A. (Univ. of California, Berkeley). Phys. Lett.; 47B: No. 3, 281-284(12 Nov 1973).

The differential cross section for the reaction $\pi^-p \to n\pi^0$ was measured with high statistics at six incident beam momenta between 1.0 and 2.4 GeV/c. The results are compared with predictions of recent phase shift analyses and forward dispersion relations. (auth)

8732 STUDY OF THE CHARGE EXCHANGE REACTION $K^-p \to \bar{K}^0n$ AT MOMENTA OF 25 AND 35 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakauridze, D. B.; Kachanov, V. A.; Kut'in, V. M.; Postoev, V. E.; Prokoshkin, Yu. D.; Semenov, V. K. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 18: No. 5, 1061-1069(Nov 1973). (In Russian).

Charge exchange K^--meson-proton cross sections at the momenta of 25 and 35 GeV/c are measured. Energy dependence of the cross sections is of a power form; the K^-p charge exchange scattering cone is slowly shrinking with the energy increase. Comparing the small angle charge exchange cross section with the difference of K^-p and K^-n total cross sections a conclusion is deduced that the «shadow» correction in the K^--meson-deuteron scattering is large. (auth)

8733 CHARGE EXCHANGE SCATTERING OF π^--MESONS ON PROTONS IN THE MOMENTUM RANGE 20 TO 50 GeV/c. Bolotov, V. N.; Isakov, V. V.; Kakauridze, D. B.; Kachanov, V. A.; Kut'in, V. M.; Prokoshkin, Yu. D.; Razuvaev, E. A.; Semenov, V. K.; Sen'ko, V. A.; Rybakov, V. G. (Inst. of High Energy Physics, Serpukhov, USSR). Yadern. Fiz.; 18: No. 5, 1046-1060(Nov 1973). (In Russian).

Differential cross sections of the reaction $\pi^-p \to \pi^0n$ are measured at the momenta up to 50 GeV/c. The energy dependence of the cross section is of a power form. The scattering cone is shrinking with the energy increase. The zero-angle charge exchange scattering cross section depends on the momentum following the law $p^{-0.93 \pm 0.05}$. The charge exchange scattering cross section in the region of second maximum decreases as $p^{-2.6 \pm 0.1}$. The ρ trajectory in the interval $0 \leq -t \leq 1.5$ (GeV/c)^2 is described by the linear function $\alpha(t) = 0.56 + 0.97t$. (auth)

8734 $\pi\pi$ PHASE-SHIFT ANALYSIS FROM 600 TO 1900 MeV. Hyams, B. (CERN, Geneva); Jones, C.; Weilhammer, P.; Blum, W.; Dietl, H.; Grayer, G.; Koch, W.; Lorenz, E.; Luetjens, G.; Maenner, W.; Meissburger, J.; Ochs, W.; Stierlin, U.; Wagner, F. Nucl. Phys., B64: No. 2, 134-162(1973).

An energy-dependent and an energy-independent analysis of elastic $\pi\pi$ scattering was performed, using data for the reaction $\pi^-p \to \pi^-\pi^+n$ at 17.2 GeV/c. The $\pi\pi$ energy covers the range from 600 MeV to 1900 MeV. Apart from the well-known resonances ρ, f and g, a strong S-wave was found in the ρ and also in the f-meson region. A P-wave resonance occurs in both analyses at ~1600 MeV with a total width of 180 MeV and an elasticity of 0.25, which can be identified with the ρ' meson in its $\pi\pi$ decay mode. The zeros in the complex $\cos\theta$ plane of the scattering amplitude are studied as a function of the energy. The position of the real parts of the zeros are in qualitative agreement with the prediction of the Veneziano model. Furthermore, it is shown that an analogous relation holds for the imaginary parts of the zero trajectories. (auth)

8735 CHANNEL CROSS SECTIONS FOR $K^-p \to \Lambda^0$ + NEUTRALS BETWEEN 0.525 AND 0.820 GeV/c. Chu, R. Y. L. (Brookhaven National Lab., Upton, NY); London, G. W.; Yu, Y. P. Nucl., B64: No. 2, 109-133(1973).

A study was made of the individual channels that contribute to the reaction $K^-p \to \Lambda^0$ + neutrals in the K^- momentum range from 525 to 820 MeV/c. Total cross sections are presented for the $K^-p \to \Lambda^0\eta^0$, $\Lambda^0\pi^0$, $\Sigma^0\pi^0$, $\Lambda\pi^0\pi^0$ and $\Sigma^0\pi^0\pi^0$ channels and differential cross sections for $K^-p \to \Lambda^0\pi^0$. The data were obtained in a heavy liquid bubble chamber experiment with an average gamma detection efficiency of 70%. Only events with all decay gammas detected were used for analysis. This is the first of a series of papers on this subject and presents the experimental technique in detail. (auth)

8736 STUDY OF THE REACTION $K^+p \to K^{*0}(890)\Delta^{++}$ FROM 4.6 TO 16.0 GeV/c. Ciapetti, G. (CERN, Geneva); Eisner, R. L.; Irving, A. C. Nucl. Phys., B64: No. 2, 58-108(1973).

A systematic analysis is presented on the reaction $K^+p \to K^{*0}(890)\Delta^{++}$ for nine incident momenta between 4.6–16.0 GeV/c. Cross sections, differential cross sections and vector meson single density matrix elements are given. As a function of energy, little if any change is observed in either the shapes of the differential cross sections or in the values of the density matrix elements. The data are interpreted in terms of current ideas on t-channel exchange mechanisms. (auth)

8737 TWO CLASSES OF REACTION MECHANISM IN π^+p INTERACTIONS AT 8 TO 23 GeV/c. Aachen-Berlin-Bonn-CERN-Cracow-Heidelberg-Warsaw Collaboration. Nucl. Phys., B64: No. 2, 34-44(1973).

The longitudinal correlations between the proton and the most forwardly produced beam-like pion (π_f) are studied in the reactions $\pi^+ + p \rightarrow \pi_f + p +$ anything at 8, 16 and 23 GeV/c. Maxima are observed in the two-particle inclusive cross sections which can be interpreted as resulting mainly from (a) diffractive processes and (b) mechanisms of central particle production. The average multiplicity of final state particles is lower and increases more slowly with increasing energy for diffractive processes than for the central production. (auth)

8738 MEASUREMENT OF THE REAL PART OF THE K^-p ELASTIC SCATTERING AMPLITUDE AT 10 GeV/c. Campbell, J. R.; Cocconi, V. T.; Duinker, P.; de Groot, H.; Hansen, J. D.; Head, A.; Howie, J. M.; Kellner, G.; Morrison, D. R. O. (CERN, Geneva). Nucl. Phys., B64: No. 2, 1-13(1973).

Bubble chamber film of 10 GeV/c K^-p interactions was scanned automatically by an H. P. D. to look for small angle scatters in the $|t|$-range from 0.008 to 0.1 GeV^2. Combining the 1800 events so obtained with 22,000 elastic events obtained from normal scanning ($|t| > 0.06$ GeV^2), the real part of the elastic scattering amplitude was found to be $(+25 \pm 10)\%$ of the imaginary part. Evidence is found for a change in slope in the differential cross-section distribution, from 9.8 ± 0.6 GeV^{-2} in the $|t|$-range below 0.1 GeV^2 to 7.1 ± 0.2 GeV^{-2} in the range $0.12 < |t| \leq 0.4$ GeV^2. (auth)

8739 STUDY OF THE REACTION $\pi^-p \rightarrow p\pi^+\pi^-\pi^-\pi^0$ AT 18.5 GeV/c. Cason, N. M.; Madden, W. B.; Bishop, J. M.; Biswas, N. N.; Kenney, V. P.; Shephard, W. D.; Smith, P. H. (Univ. of Notre Dame, IN). Nucl. Phys., B64: No. 2, 14-28 (1973).

Analysis of 168,000 pictures of π^-p interactions at 18.5 GeV/c in the BNL 80 inch hydrogen bubble chamber has yielded a clean sample of 3583 events of the type $\pi^-p \rightarrow p\pi^+\pi^-\pi^-\pi^0$. The cross section for this reaction was determined to be 0.86 ± 0.12 mb. The reaction is peripheral, 77% of the events having four-momentum-transfer squared from target proton to outgoing proton less than 1.0 (GeV/c)^2. Evidence is presented for the production of several resonances, the most abundant being $\rho^0,\rho^-,\omega^0,\eta^0,B^-$, ρ (1710), and Δ^{++}(1236). Masses, widths and production cross sections are given for the resonances. A cross section of 0.007 ± 0.002 mb was obtained for the production of the A_2^- followed by an $\eta^0\pi^-$ decay. The ratio $[A_2^- \rightarrow \eta^0\pi^-]/[A_2^- \rightarrow (\rho\pi)^-]$ was determined to be 0.28 ± 0.09. (auth)

8740 INTERACTIONS OF STOPPING K^- MESONS WITH NUCLEI AND THE NEUTRON HALO QUESTION. Bugg, W. M. (Univ. of Tennessee, Knoxville); Condo, G. T.; Hart, E. L.; Cohn, H. O.; McCulloch, R. D. Nucl. Phys., B64: No. 2, 29-33(1973).

From a study of stopping K^- meson interactions in a variety of elements located in a hydrogen bubble chamber, evidence is found for the existence of a substantial neutron halo in the periphery of heavy nuclei. (auth)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 9270, 9274, 9275, and 9287.

8741 (JINR-P4-7105) PHASE FUNCTION METHOD IN RELATIVISTIC THEORY OF QUASIPOTENTIAL SCATTERING. I. Two-body Problem. Amirkhanov, I. V.; Grechko, V. E.; Dement'ev, R. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

Ordinary nonlinear differential equations for partial amplitudes, scattering phases, and s-matrix elements, that take into account the relativistic kinematics of two interacting particles are derived. (auth)

8742 (RL-73-94) GENERALIZED RAPIDITY FOR SPACE-LIKE PARTICLES. Uschersohn, I. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Sep 1973. 6p. Dep. NTIS (U. S. Sales Only) $3.00.

A new longitudinal variable is introduced. It can describe both time-like and space-like particles. (auth)

8743 GEOMETRY AND PHYSICS OF THE ELEMENTARY PARTICLES. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 83-95 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

The problem of geometry in the physics of elementary particles is discussed under the following heading: ordering of events in macroscopic physics; restrictions imposed by gravitation; point-like events in the microworld; the restrictions on the elementary particle mass by gravitational considerations; the peculiarities of weak interactions; weak maximum, and the "blackness" of particles and locality. (LBS)

8744 COVARIANCE OF THE CONSERVED CURRENT EQUATIONS AND TRANSFORMATIONS OF NOETHER'S CURRENT. Bayen, F.; Hillion, P. (Institut Henri Poincare, Paris). J. Math. Phys. (N. Y.); 14: No. 9, 1164-1169(Sep 1973).

The covariance of the conserved current equations is first proved in a direct way without using the transformation laws of Noether currents. Then the transformation of these currents is investigated and, when the action integral is invariant up to a divergence, a result is found which does not seem to have been noted previously. (auth)

8745 SYMMETRY CONSTRAINTS OF INCLUSIVE REACTIONS IN THE PIONIZATION REGION. Leroy, C.; van Parijs, J. (Univ., Louvain, Belgium). Ann. Soc. Sci. Brux. Ser. I; 87: No. 3, 357-365(1973).

The constraints on inclusive cross sections in the pionization region imposed by isospin conservation and by Mueller's theorem are considered assuming that Regge poles are exchanged. This will enable one to compare different reactions with respect to the way they reach the scaling limit. (auth)

8746 CONFORMALLY INVARIANT MASSIVE AND MASSLESS SPINOR EQUATIONS. II. Solutions of the Wave Equations. Barut, A. O.; Haugen, R. B. (International Centre for Theoretical Physics, Trieste, Italy). Nuovo Cim., 18A: No. 3, 511-531(1 Dec 1973).

The simplest possible conformal invariant spinor equations account completely for the known lepton states and their quantum numbers. In the massive case, a system with eight states is obtained: four satisfy the Dirac equation, when reduced to the Minkowski space, the other four are unstable leptons with apparent maximal parity-violating interaction terms, although the original conformal invariant equations conserve parity. For the massless case, the corresponding eight two-component spinors are obtained. (auth)

8747 GEOMETRY AND PHYSICS OF THE MICROWORLD. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Usp. Fiz. Nauk; 110: No. 4, 481-497(Aug 1973). (In Russian).

A critical analysis is given of the main geometrical concepts applicable to the physics of the microworld. An outline of geometry in macroscopic physics is first presented. This is based on the classical studies of A. Poincare, A. Einstein and A. A. Freidman. A new point of view is the indication of a possible limitation on the concept of a point event connected with the limiting density of a substance. Localization of elementary particles is discussed, and the limits of possible accuracy are indicated. It is emphasized that the logical structure of local quantum field theory assumes the existence of particles having a mass of any magnitude. The existence of "maximons", which are particles of a limiting but limited mass, is in contradiction with locality. Physical reasons are presented for the existence of limiting finite masses: strong gravitation (particle collapse), instability of particles with respect to decay because of weak interaction (this interaction may become strong for very heavy particles and may lead to complete instability of the particle). Consideration is given to two points of nonlocal field theory. In this theory the coordinates of a point event are operators, while momentum space remains numerical space (curved or plane). The first variant assumes commutation conditions for point coordinates (theory of Snider-Kadyshevskii; the second variant assumes anti-commutation conditions (theory of the author). 47 references. (auth)

8748 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 13, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 95p.

8749 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 11, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 88p.

8750 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 10, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 81p.

8751 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 12, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 90p.

Electromagnetic

Refer also to abstracts 8912 and 9294.

8752 (BNL-tr-547) PRODUCTION OF RADIATION BY A CHARGED PARTICLE MOVING THROUGH A CONTINUOUS PERIODIC MEDIUM. Garibyan, G. M.; Yang, C. (AN Armyanskoj SSR, Erevan. Inst. Fiziki). 1973. Translated by S. J. Amoretty from EFI-16(73). 36p. Dep. NTIS $4.00.

The radiation from a charge in a continuously periodic medium is considered in the light of the modified perturbation theory. In the limiting cases in which the radiation frequency is sufficiently far away from the Bragg frequency the equations obtained become those of the classical perturbation theory. Near the Bragg frequencies the equations obtained differ markedly from the well known equations. (JFP)

8753 (DESY-73/35) INCLUSIVE PHOTO- AND ELECTRO-PRODUCTION OF PIONS IN THE TRIPLE REGGE REGION. Craigie, N. S.; Kramer, G.; Koerner, J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1973. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

A Regge pole expansion including spin is developed for inclusive photo- and electroproduction of pions in the photon fragmentation region and to see to what extent the available data at intermediate energies can be explained in terms of Regge poles alone. It is shown that a pure Regge pole model is not adequate, although some qualitative features are reproduced. (auth)

8754 (IAE-2213) EFFECT OF THE MEDIUM ON THE BRAKING SPECTRUM OF HIGH ENERGY ELECTRONS. (Plan of the Experiment). Varfolomeev, A. A.; Glebov, V. I.; Denisov, E. I.; Khlebnikov, A. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The possibility of the experimental detection of the effect of multiple scattering on the bremsstrahlung spectrum of high energy electrons produced by the accelerator was indicated. Numerical calculations were made of the electron bremsstrahlung with energy above 40 GeV in different materials with consideration of the effect of the medium on the bremsstrahlung process. It was shown that the effect of multiple scattering is clearly shown at electron energy $\geq$ 40 GeV in the energy range of bremsstrahlung quanta of 10 to 100 MeV in heavy elements. Specific experimental installation for the measurement of the bremsstrahlung spectra in this energy range is examined. An evaluation was made of the cost of the operating time of the machine and the expected precision of the measurement. (tr-auth)

8755 (JINR-E2-7333) SPIN STRUCTURE OF ELECTROMAGNETIC INTERACTION OF TWO RELATIVISTIC PARTICLES. Skachkov, N. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

In quasi-potential equation for particles with spin ½ Feynman matrix elements, corresponding to diagrams of one-photon exchange, are taken as quasi-potential. It is shown that they can be parametrized in terms of Lobachevsky space elements in such a way that the spin structure of electromagnetic interaction of two relativistic particles looks like the geometrical generalization of the spin structure of Breit interaction (in the sense of change of Euclidean geometry to Lobachevsky one). (auth)

8756 (JINR-E2-7560) EFFECT OF THE CHOICE OF $\pi\pi$-SCATTERING PHASE PARAMETRIZATION ON $\gamma\gamma \to \pi\pi$ AND $\gamma\gamma \to \gamma\gamma$ REACTION CROSS SECTIONS. Isaev, P. S.; Khleskov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The cross sections of the processes $\gamma + \gamma \to \pi + \pi$ and $\gamma + \gamma \to \gamma + \gamma$ for the case, when the $\pi\pi$ phase shifts are going to π in the asymptotic regions, were obtained. The importance of the use of the general solution of the homogeneous integral equation for obtaining the solution of the integral dispersion relation was pointed out. (auth)

8757 (LNF-73/51) POSSIBLE IMPLICATIONS OF THE GRIBOV–LIPATOV RECIPROCITY RELATIONS IN INCLUSIVE PROCESSES. Etim, E.; Ferrara, S.; Grillo, A. F. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 31 Aug 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

The consequences of the Gribov–Lipatov reciprocity relations are studied for single particle inclusive distribution in $e^+ + e^-$ annihilation and the pion structure functions. (JFP)

8758 LECTURES IN LIGHT CONE PHYSICS. Preparata, G. (Univ., Rome). pp 209-277 of Proceedings of the Seventh Finnish Summer School in Physics, Loma–Koli, Finland, June 26–July 7, 1972. Pellinen, R. (ed.). Helsinki; Univ. of Helsinki (1972).

From seventh Finnish summer school in physics, modern developments in hadron physics; Loma–Koli, Finland (26 Jun 1972). See CONF-720693-.

A report is given on the progress which has been achieved through the configuration space description of deep inelastic processes, and the realization that in such formulation one needs only to consider the behavior of products of current operators near the light cone. The five lectures are concerned with: the physics of the light cone; light cone expansions and technology; light cone description of deep inelastic scattering off a nucleon; the light cone and e^+e^- colliding beam physics; and crossing in light cone physics. (LBS)

8759 PION FORM FACTOR BEYOND THE ρ MESON. Roos, M. (Univ. of Helsinki). pp 325-350 of Proceedings of the Seventh Finnish Summer School in Physics, Loma–Koli, Finland, June 26–July 7, 1972. Pellinen, R. (ed.). Helsinki; Univ. of Helsinki (1972).

From seventh Finnish summer school in physics, modern developments in hadron physics; Loma–Koli, Finland (26 Jun 1972). See CONF-720693-.

The properties of the pion form factor function are investigated by means of the $e^+e^- \to \pi^+\pi^-$ colliding-beam interaction. The form factor is expressed in terms of the Omnes function, and the behavior at energies beyond the ρ is studied. Various fits to the elastic $\pi\pi$ phase shifts are attempted. It is concluded that a ρ' strongly coupled to the elastic $\pi\pi$ wave cannot explain the data. The results obtained are offered as support to the idea that the ρ' is to be found as a resonance in the inelastic channels, and that this will be sufficient as an explanation of the high $|F_\pi|^2$ data points. (LBS)

8760 PION FORM FACTOR IN THE SPACELIKE REGION FROM π^+ ELECTROPRODUCTION. Kellett, B. H. (Univ. of Manchester, Eng.); Verzegnassi, C. pp 351-358 of Proceedings of the Seventh Finnish Summer School in Physics, Loma–Koli, Finland, June 26–July 7, 1972. Pellinen, R. (ed.). Helsinki; Univ. of Helsinki (1972).

From seventh Finnish summer school in physics, modern developments in hadron physics; Loma–Koli, Finland (26 Jun 1972). See CONF-720693-.

The possibility of deriving the pion form factor from π^+ electroproduction using a procedure different from the standard Chew-Low extrapolation procedure is discussed. The idea is to use dispersion relations to write down an expression of the scattering amplitude where everything, apart from the pion form factor, can be considered as known, so that a measurement of the amplitude from the data allows one to measure $F_\pi(K^2)$. (LBS)

8761 EXOTIC CURRENTS IN HADRONIC ELECTROMAGNETIC INTERACTIONS. Baldini-Celio, R. (CNEN, Frascati, Italy). pp 381-408 of Proceedings of the Seventh Finnish Summer School in Physics, Loma–Koli, Finland, June 26–July 7, 1972. Pellinen, R. (ed.). Helsinki; Univ. of Helsinki (1972).

From seventh Finnish summer school in physics, modern developments in hadron physics; Loma–Koli, Finland (26 Jun 1972). See CONF-720693-.

Some exotic consequences of new experimental results that have been obtained by studying pion photoproduction on neutrons are discussed. These include: evidence for a time reversal invariance violation in hadronic electromagnetic interactions and evidence for a violation of the $\Delta I \leq 1$ rule in electromagnetic interactions. The hypothesis of Sanda and Shaw on the connection between these two violations is discussed in terms of the experimental situation, namely, that it is the isotensor part of the hadronic electromagnetic current which violates T invariance. (LBS)

8762 γ–γ INTERACTION PROCESSES AND e^+e^- COLLIDING BEAM EXPERIMENTS IN THE GeV RANGE. Stella, B. (Univ., Rome). pp 409-433 of Proceedings of the Seventh Finnish Summer School in Physics, Loma–Koli, Finland, June 26–July 7, 1972. Pellinen, R. (ed.). Helsinki; Univ. of Helsinki (1972).

From seventh Finnish summer school in physics, modern

developments in hadron physics; Loma-Koli, Finland (26 Jun 1972). See CONF-720693-.

An attempt is made to underline the relevance of photon-photon annihilation in the physics of e^+e^- colliding beam experiments in the GeV range. The main features of the process $e^+e^- \rightarrow e^+e^-+$ anything are first summarized. Some results obtained for the reactions $e^+e^- \rightarrow e^+e^-e^+e^-$, $e^+e^- \rightarrow e^+e^-\mu^+\mu^-$, and $e^+e^- \rightarrow e^+e^-\pi^+\pi^-$ are discussed. (LBS)

8763 NONRELATIVISTIC OFF-SHELL TWO-BODY COULOMB AMPLITUDES. Chen, J. C. Y.; Chen, A. C. (Univ. of California, San Diego, La Jolla). Advan. At. Mol. Phys.; 8: 71-129(1972).

A review of the off-shell two-body Coulomb T-matrix is presented including analyticity and screening. (JFP)

8764 O(3,1) SYMMETRY MODEL AND COMPTON SCATTERING OF PROTONS. Saleem, M. (Punjab Univ., Lahore). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2071-2078(Jun 1973).

It is shown that non-forward ($t < 0$) Compton scattering can be explained on O(3,1) symmetry model. The agreement between theory and experiment is found to be very good. (auth)

8765 SPACE-TIME QUANTIZATION AND CHERENKOV EMISSION AT VELOCITIES $v > c$. Meessen, A.; Bilocq, L. (Univ., Louvain, Belgium). Ann. Soc. Sci. Brux. Ser. I; 87: No. 3, 366-386(1973).

The value α of the ultimate limit for the smallest measurable distance should be considered as an unknown quantity, instead of assuming that $\alpha = 0$, as is done in usual continuum theories. The corresponding generalization of physical laws implies the use of finite-difference equations and a modification of Einstein's energy-momentum relation, with the conclusion that a material body can move at a velocity $v > c$, when $\alpha \neq 0$. The theory which was developed so far, and which applies only to free particles, is extended here to the case of interacting particles, to account for the Cherenkov radiation that will be emitted by any charged particle, moving at a velocity $v > c$. It is found that the usual quantum-mechanical selection rules for the energy and momentum variables are still valid when $\alpha \neq 0$, and that the spectral distribution of the emitted light can be predicted by means of a generalization of the usual classical theory of the Cherenkov effect. Some important implications with respect to the principle of relativity are also discussed. (auth)

8766 NONLEPTONIC DECAYS AND SUB-HADRONIC INTERACTION. I. Studies of Kaon Decays. Katuya, M. (Hokkaido Univ., Sapporo); Koide, Y. Progr. Theor. Phys. (Kyoto); 49: No. 6, 2192-2195(Jun 1973).

From a viewpoint of the composite model of hadrons, the electromagnetic and weak interactions of pseudoscalar mesons are investigated under the following assumption: A reaction takes place only when the urbaryons (of which hadrons are composed) concentrate on one point of the space-time where and when those primary interactions take place. Especially investigation is made into the kaon nonleptonic decays by employing some types of the primary weak Hamiltonian of the nonleptonic decays at the urbaryon level. As possible candidates, three cases, i.e., $\mathcal{H}^{I} = \sin\theta\cos\theta G_0(\bar{t}_2\gamma_\rho(1-i\gamma_5)t_1)(\bar{t}_1\gamma^\rho(1-i\gamma_5)t_3) +$ h.c., $\mathcal{H}^{II} = \bar{t}_2(g_{pc}1 + g_{pv}i\gamma_5)t_3 +$ h.c. and $\mathcal{H}^{III} = G(\bar{t}_2\gamma_\rho(1-i\gamma_5)t_3)(\bar{t}_1O^\rho t_1) +$ h.c. are examined. In these expressions $t_i (i = 1, 2, 3)$ denotes the urbaryon triplet. It is shown that neither $\mathcal{H}^{I}$ nor $\mathcal{H}^{II}$ is acceptable as the "primary" Hamiltonian; instead, the case $\mathcal{H}_{NL} = (G_0/\sqrt{2})(\bar{t}_2\gamma_\rho(1-i\gamma_5)t_3)(\bar{t}_1\gamma^\rho t_1) +$ h.c. appears as a preferable choice among the cases $\mathcal{H}^{III}$. Implications of these results are also discussed. (auth)

8767 AUTOMODEL ASYMPTOTICS OF ELECTROMAGNETIC FORM-FACTORS AND THE BEHAVIOR OF THEIR FOURIER TRANSFORMS NEAR THE LIGHT CONE. Zav'yalov, B. I. (Inst. of Mathematics, Moscow). Teor. Mat. Fiz.; 17: No. 2, 178-188 (Nov 1973). (In Russian).

The notion of the quasi-asymptotics of generalized function at the infinity is introduced. Sufficient condition of automodelity is given in terms of quasi-asymptotic properties of the spectral function in the Jost-Lehmann-Dyson representation. The exact correspondence between these properties and the behavior of the Fourier transforms of the form-factors near the light cone is established. (auth)

8768 WAVE PACKETS OF RELATIVISTIC ELECTRONS. Bakke, F.; Wergeland, H. (Univ. of Trondheim, Norway). Physica; 69: No. 1, 5-11(Oct 1973).

It is shown that wave packets of the δ-function type can be constructed without invoking negative energies. The position uncertainty is computed for a typical packet. Unlike the purely diffusive spreading known from nonrelativistic quantum mechanics, the relativistic wave packets always have a wave-like precursor on the light cone. (auth)

8769 PRODUCTION OF NUCLEON RESONANCES IN INELASTIC ELECTRON-NUCLEON SCATTERING. Mukhtarov, A. I.; Sadykhov, F. S.; Vasil'ev, O. A. (Azerbaydzhan State Univ., Baku). Yadern. Fiz.; 18: No. 5, 1092-1097(Nov 1973). (In Russian).

Production of the nucleon Δ resonances with spin $^3/_2$ and various parities in inelastic electron-nucleon scattering is investigated with account of polarizations of the target proton and of scattered leptons. The obtained results are compared with the known experimental data on the resonances Δ(1236), Δ(1670), and Δ(2160). Angular dependence of the longitudinal polarization of the scattered electrons was studied. (auth)

8770 HIGH-ENERGY BEHAVIOR OF TOTAL CROSS SECTIONS OF e^+e^- SCATTERING AND THE LAMB SHIFT. Kuraev, E. A.; Lipatov, L. N.; Merenkov, N. P. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 5, 1075-1091(Nov 1973). (In Russian).

Radiative corrections up to the 8th order of the perturbation theory to the e^+e^- elastic scattering amplitude are calculated at high energies and fixed momentum transfers. This enables one to get the e^+e^- total interaction cross section as a sum of the eikonal expression and two terms corresponding to the Bethe-Heitler mechanism of the e^+e^- pair production. On the other hand, the total cross section is a sum of the elastic scattering cross section, the brehmsstrahlung of one and two γ quanta, the electron-positron pair production. Therefore it is possible to express the slope of the Dirac form factor at $q^2 = 0$, that determines the elastic cross section, in terms of cross sections for other high-energy processes. An excellent agreement between the high-energy and low-energy calculations is obtained. (auth)

8771 HADRON PRODUCTION IN THE VIRTUAL PHOTON FRAGMENTATION REGION. Ansel'm, A. A.; D'yakonov, D. I. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 5, 1098-1107(Nov 1973). (In Russian).

Two mechanisms of hadron electroproduction in the virtual photon fragmentation region are considered. In order to describe the first of them (Regge mechanism) it is necessary to know the photon-reggeon-particle vertex. Arguments are presented for a possible universal dependence of this vertex on the photon mass q^2 and its relation to the form factors is also discussed. For electroproduction of particles with integer spin the spin structure of the leading term in energy and q^2 is brought forward. The universality hypothesis leads to a certain factorization behavior of the inclusive cross section of particle production by the virtual photon. A consideration of the second (≪parton≫) mechanism leads to another factorization law, obtained by Drell and Yan. The main experimental predictions are listed at the end of the paper. (auth)

8772 A_1 (1070) ELECTROPRODUCTION. Read, B. J. (DESY, Hamburg). Nucl. Phys., B64: No. 2, 511-524(1973).

A simple estimate of the cross section for electroproduction of the A_1 (1070) meson resonance is presented: it could probably be observed in present experiments. The status of the A_1 and the nature of its coupling to the $\pi\rho$ system are summarized. A_1 photoproduction and its production in e^+e^- annihilation are also considered. (auth)

8773 CONNECTION BETWEEN THE ELECTROMAGNETIC FORM FACTORS OF HADRONS AND SIDEWISE DISPERSION RELATIONS. Bluvstein, R. E.; Cheshkov, A. A.; Dubovik, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Phys., B64: No. 2, 407-428(1973).

It is shown that the analyticity of electromagnetic form factors in the invariant hadron masses and the unitarity condition lead to a system of linear relations between various form factors. The construction of such a system is a general way of expressing the hardly measured inelastic form factors in terms of the elastic ones. In the concrete case this system for the form factors; $F_\pi(k^2)$, $F_{\omega\pi\gamma}(k^2)$, $F_{\rho\pi\gamma}(k^2)$ and $F_{N^*(1470)\gamma}(k^2)$, allowing one to express them in terms of the nucleon form factors, was obtained by sidewise dispersion relations in elastic unitarity. The obtained meson form factors behave like k^{-2} for large k^2. The pion radius $\langle r_\pi \rangle$ is equal to $\langle r_\pi \rangle = 0.68$ fm. The system of equations leads to a ratio $[(1^{(1+\mu^p)}p^n/G_M^p]^2$ which deviates from scaling in the region $k^2 \approx 4.2$ GeV^2 but not at $k^2 = 0$ and $k^2 \gg 2$ GeV^2. In the framework of the Chew-Goldberger-Low-Nambu approach, a model of electroproduction for the saturation of the sidewise dispersion relation has been chosen so that besides the Born terms we take into account the exchange of ω,ρ mesons in the t-channel as well as the magnetic dipole $M_{1+}^{3/2}$ and electric quadrupole $E_{1+}^{3/2}$ of the Δ_{33} resonance in the u-channel. (auth)

8774 NUCLEAR PHOTOPRODUCTION OF CHARGED PIONS NEAR THRESHOLD. Koch, J. H.; Donnelly, T. W. (Stanford Univ., CA). Nucl. Phys., B64: No. 2, 478-485(1973).

Total cross sections for photoproduction of charged pions from nuclei near threshold are calculated. The full nuclear potential is included in the distortion of the produced pion. (auth)

8775 SPIN DEPENDENT HIGH FREQUENCY INELASTIC ELECTRON SCATTERING AND HELICITY FLIP COUPLINGS. Heimann, R. L. (Cavendish Lab., Cambridge, Eng.). Nucl. Phys., B64: No. 2, 429-463(1973).

The Bjorken scaling and Regge behaviors expected in the high energy inelastic scattering of polarized electrons on a polarized nucleon target are examined. Attention is concentrated on the occurrence of operators or exchanges that couple predominantly to non-zero helicity flips (M) in forward single hadron matrix elements. Bilocal operators in the light cone expansion, with $M \neq 0$, have previously been argued to be detectable through changes in the zero moment sum rule of the Bjorken scaling function g_2. It is shown that this is not the case when one consistently imposes current conservation on the light cone, and that the usual expansion already fully includes the $M \neq 0$ bilocals. Instead, $M \neq 0$ exchanges can show up in the Regge limit, and be easily detectable. If cuts occur, the cross section is a factor ν^2 higher in ν-dependence than with ordinary poles. These results are applied to fixed mass and scaling function sum rules, the hydrogen hyperfine structure, and are viewed in the light of positivity restrictions. Maximal Regge behavior for spin dependent structure functions excludes the avoidance of the unknown subtraction constant in dispersive calculations of the proton-neutron electromagnetic mass difference. (auth)

8776 PARITY VIOLATION, AND COMPARISONS BETWEEN QUARK-SCHEMES AND M-SCHEMES IN UNIFIED GAUGE THEORIES. Bars, I. (Univ. of California, Berkeley). Nucl. Phys., B64: No. 2, 163-172(1973).

Quark-schemes and M-schemes are compared and contrasted as viable approaches to the unification of strong, weak and electromagnetic interactions, and intimate correspondences between them are established. It is shown, contrary to recent claims, that the M-scheme does not lead to large parity and hypercharge violation. Parity and hypercharge violation are arbitrary and adjustable to any small value. (auth)

8777 THREE-PHOTON INTERACTION IN AN INTENSE FIELD AND SCALE INVARIANCE. Papanyan, V. O.; Ritus, V. I. (Inst. of Physical Research, Erevan). Zh. Eksp. Teor. Fiz.; 65: No. 5, 1756-1771(Nov 1973). (In Russian).

A three-photon vertex function (polarization tensor of third rank) is obtained which describes the interaction between three real or virtual photons in an intense constant electromagnetic field of the type E⊥H, E = H. The extreme cases of small energies and virtualities and of high energies are considered. In the latter case the vertex function possesses scale invariance, the role of the mass scale being played by the variable $L^{\frac{1}{3}}$ which is related to the photon momentum and the field: $L_\mu = eF_{\mu\nu}l_\nu$. It is shown that the probability for photon splitting, $\gamma \to \gamma' + \gamma''$ is sensitive to the real and imaginary parts of the photon masses in the field due to the closeness of the boundary of the final photon spectrum to its maximum. (auth)

8778 CALCULATION OF SPECTRUM OF 0.5 TO 1 MeV ELECTRON BREMSSTRAHLUNG IN A THICK TARGET LAYER. Guseva, N. S. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 37-45 of Voprosy Yadernoi Geofiziki i Neftegazopolskovoi Geokhimii. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

A method for the calculation of the electron bremsstrahlung with energy of 0.2 to 1 MeV with consideration of the corresponding corrections was described. A simple approximation formula for fast evaluation was given. A method for the calculation of the forms of bremsstrahlung from thick layers of heavy material with consideration of the back scattering of electrons from the layers was described. The spectral distribution curves of the γ radiation from thick tungsten layers for electrons with original energy of 0.5 and 1 MeV were given. A comparison was made with experimental data. (tr-auth)

8779 GAUGE THEORIES. Lee, B. W. (State Univ. of New York, Stony Brook). pp 125-128 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

Introductory comments are made on the subject of gauge theories of weak and electromagnetic interactions. (LBS)

8780 UNIFIED GAUGE THEORIES OF STRONG, WEAK, AND ELECTROMAGNETIC INTERACTIONS. Halpern, M. B. (Univ. of California, Berkeley). pp 129-141 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

Some salient features and some details are given on the form of a recent unified gauge (renormalizable) theory of strong, weak, and electromagnetic interactions, which requires the existence of a new set of scalar and pseudoscalar fields (M). Some new developments on the observability of M's, scaling, and finite electromagnetic mass differences and parameter reduction are briefly reported. (LBS)

Weak

Refer also to abstract 8473.

8781 (FRNC-R-22, pp 77-94) CALCULATIONS IN AND CONSTRAINTS ON A MODEL OF WEAK INTERACTIONS. Primack, J. R. (Harvard Univ., Cambridge, MA). 1972.

From meeting on renormalization of Yang–Mills fields and applications to particle physics; Marseilles, France (19 Jun 1972).

The results of some calculations made in the framework of the spontaneously broken O_3 gauge model of weak and electromagnetic interactions by Howard Georgi and Shelly Glashow are discussed. It is shown how this model fits into several different classification schemes established for models of this sort. Several phenomena associated with this model (anomalous magnetic moments of μ and e, scattering, strangeness-changing decays) are described and the constraints on the model developed are discussed. (auth)

8782 (FRNC-R-22, pp 95-110) HIGHER ORDER CALCULATIONS IN A GAUGE MODEL OF WEAK INTERACTIONS. Appelquist, T. (Harvard Univ., Cambridge, MA). 1972.

From meeting on renormalization of Yang–Mills fields and applications to particle physics; Marseilles, France (19 Jun 1972).

A calculation of the higher order (one loop) contributions to μ-decay in the Weinberg model of weak and electromagnetic interactions is described. The calculation requires a careful treatment of renormalization and is interesting for exploring the structure of spontaneously broken gauge theories. The results are only negligibly different from the old calculations of the radiative corrections to the current-current theory. Other processes and other models are also discussed. (auth)

8783 (FRNC-R-22, pp 127-139) CALCULATION OF STATIC QUANTITIES IN WEINBERG'S MODEL. Lautrup, B. (CERN, Geneva). 1972.

From meeting on renormalization of Yang–Mills fields and applications to particle physics; Marseilles, France (19 Jun 1972).

The calculations performed show that the Weinberg model is renormalizable at least at the one-loop level. (auth)

8784 (JINR-E2-7416) POSSIBLE TEST FOR NEUTRAL CURRENTS AT LOW ENERGIES. Bilen'kii, S. M.; Dadayan, N. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

A possible method of investigating the neutral currents predicted by renormalizable theories of weak and electromagnetic interactions is suggested. Neutrino (antineutrino) absorption in nuclei leading to states of collective vibrations (giant dipole) is investigated. The lower limit of the cross section of this process for a number of nuclei is estimated. (auth)

8785 (JINR-P2-7240) μ-DECAY AND NEUTRON–NEUTRON INTERACTIONS IN NONLOCAL THEORY OF WEAK INTERACTIONS. Zibol'd, K.; Malyshkin, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

In the framework of nonlocal theory of weak interactions there were taken into account the second order corrections to the μ-decay spectrum which are due to both ordinary four-Fermion and neutron-neutron interactions. The comparison of the calculated results with experimental data allows one to obtain upper constraint for the v-v-interaction coupling constant. (auth)

8786 (LNF-73/39) NEUTRINO DIFFERENTIAL CROSS SECTION ($d\sigma/dQ^2$) PREDICTIONS AS FUNCTION OF INTERMEDIATE BOSON (W) MASS. Bergamasco, L.; D'Ettorre Piazzoli, B.; Picchi, P.; Visentin, R. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 2 Jul 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The differential cross sections for the reactions of neutrinos of

energies from 100 to 500 GeV with neon nuclei calculated for different values of the intermediate boson mass are given. (JFP)

8787 TESTS FOR A WEAK NEUTRAL CURRENT IN $l^1 + N \rightarrow l^1$ + ANYTHING AT HIGH ENERGY. Derman, E. Columbia, NY; Columbia Univ. (1973). 80p. University Microfilms Order No. 73-28,199.

Thesis (Ph. D.).

A study is made of tests for a weak neutral current in the inclusive process $l^1 + N \rightarrow l^1$ + anything (1.1) at high energy, as well as estimates of the size of possible effects. A simple phenomenological interaction of variable strength is chosen in order to plausibly estimate the size of typical effects. Section II contains the cross section for (1.1) where the incoming lepton is polarized, in the presence of J_μ^W, in the zero lepton mass approximation. It is expressed in terms of the nucleon structure functions describing the nucleon–current interaction. Their scaling properties and positivity constraints are considered in Appendix A. The cross section with all lepton mass–dependent terms, and an estimate of their magnitude is in Appendix B. In Section III tests for parity violation using a variable incoming lepton polarization are considered. A plausible form for J_μ^W is chosen, and parity violating effects are calculated in the generalized quark-parton model of Llewellyn–Smith, and in the more specific model of Kuti and Weisskopf. The dependence of such effects on energy, coupling strength and mass of the hypothetical intermediate vector boson is displayed in a series of graphs. Finally the case where instead the final lepton's polarization is measured as a test of parity violation is simply related to the effects already considered. Section IV then contains a similar treatment of tests for J_μ^W which utilize either the lepton charge dependence of reaction (1.1), or the deviation of the cross section from the energy dependence of the one photon exchange form. Section V contains the kinematics and cross section for (1.1) in the presence of J_μ^W when the target is polarized. In VI estimates of the parity violation when the target spin is varied are calculated in the Kuti–Weisskopf model. Tables of structure functions in the various models are given in Appendix C. (LBS)

8788 SUM RULES FOR RADIATIVE WEAK NONLEPTONIC DECAYS. Kohara, Y. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2159-2160(Jun 1973).

Sum rules are obtained for the parity conserving radiative weak nonleptonic decays of hyperons on the basis of unsubtracted dispersion relations. (LBS)

8789 INEQUALITIES IN NEUTRAL K-MESON DECAY. Ito, Y. (Fukushima Univ., Japan). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2137-2138(Jun 1973).

Restrictions on $(\mathrm{Im}A_2)^2$ and the CP-violating parameter in K^0 decay are derived in the general frame of Wu and Yang's phenomenological analysis, making use of Schwarz's inequality. (LBS)

8790 PARITY VIOLATING NEUTRAL CURRENTS IN WEAK INTERACTIONS. Kuroda, M.; Yamaguchi, Y. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2160-2162(Jun 1973).

The possibility of detecting weak neutral currents and the parity violating effect in $e^+e^- \rightarrow \mu^+\mu^-$, $e^+e^- \rightarrow \Sigma\bar{\Sigma}$ $(\Lambda\bar{\Lambda})$, $e^+e^- \rightarrow \pi^+\pi^-$, and $e^+e^- \rightarrow pX$ $(\Lambda X, \Sigma^+ X)$ colliding-beam interactions is discussed. It is concluded that, at present, the practical possibility is limited to the pure leptonic processes. (LBS)

8791 WEAK INTERACTIONS AT SMALL DISTANCES. Ioffe, B. L. (Inst. of Theoretical and Experimental Physics, Moscow). Usp. Fiz. Nauk; 110: No. 3, 357-404(Jul 1973). (In Russian).

The weak interaction increases with increasing energy. The form of the interaction is presented. Real processes at high energy include: elastic scattering of leptons, the interaction of the neutrino with nucleons, inelastic scattering of leptons, lower limit for elastic e^+e^--scattering cross section, the behavior of the total cross sections of the weak interactions of leptons at energies above the unitary limit. Under virtual processes the review covers: lepton interactions, electromagnetic interactions of leptons, weak interactions of leptons such as μ-decay, elastic $\nu_e e^-$-scattering, elastic $\nu_\mu e$-scattering and elastic e_e-scattering, hadron–lepton interactions, weak neutral currents, ratio of vector constant of β- and μ-decay, nonleptonic interactions, and hadron processes with a change in strangeness, parity or isotopic spin. Also attempts to construct a new theory of weak interactions are considered. 114 references. (SJR)

8792 LEPTON NUMBER VIOLATION IN DOUBLE-BETA DECAY. Smith, D. (Univ. of Victoria, B. C.); Picciotto, C.; Bryman, D. Nucl. Phys., B64: No. 2, 525-530(1973).

A model for neutrinoless double-beta decay is presented in which the lepton-violating two-electron current couples to the nucleus in a first-order superweak interaction with coupling strength G'. The interaction is assumed to proceed via an $N^*(1236)$, with a probability of finding the resonance in the parent or daughter nucleus of roughly 1%. The coupling strength necessary to provide results consistent with all presently available data is found to be $G' \approx 10^{-13}$ G, where G is the weak coupling strength. (auth)

8793 HIGH ENERGY NEUTRINO SCATTERING AT LOW Q^2: STRONG OR WEAK PCAC. De Vincenzi, M. (Univ., Rome); Preparata, G. Nucl. Phys., B64: No. 2, 253-268(1973).

By means of light-cone-controlled mass dispersion relations the corrections to the Adler term in low Q^2 high-energy neutrino-nucleon scattering are calculated. The corrections to strong PCAC arising in a weak PCAC framework are also computed. It is shown that experiments with reasonable statistics will be able to distinguish between strong and weak PCAC. (auth)

8794 WEAK PRODUCTION OF NUCLEAR RESONANCES IN A RELATIVISTIC QUARK MODEL. Ravndal, F. (California Inst. of Tech., Pasadena). Nuovo Cim., 18A: No. 3, 385-415(1 Dec 1973).

The cross section for neutrino excitation of a nucleon resonance can be expressed by three partial cross sections σ_R, σ_L and σ_S. These are directly given in terms of matrix elements of the weak currents. Taking the current matrix elements from a relativistic quark model, the production cross sections for all the nucleon resonances of the harmonic-oscillator baryon spectrum with mass $M < 1750$ MeV. It is found that outside the forward direction where σ_S dominates, σ_R and σ_S are small compared with σ_L in the whole resonance region considered. The calculated cross section and density matrix elements for the $P_{33}(1236)$ resonance are in good agreement with the recent Argonne experiment. (auth)

Strong (General)

Refer also to abstract 8728.

8795 THEORY OF ONE-DIMENSIONAL RELATIVISTIC ELASTIC CONTINUUM AND HADRONIC WAVE EQUATION. Takabayasi, T. (Nagoya Univ., Japan). pp 169-174 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

The relativistic quantum mechanics of a finite one-dimensional elastic continuum (string), taken as a model of hadrons, was derived by a detailed wave equation. The theory is reconstructed by first giving the classical theory of a relativistic string and then quantizing it, in such a way that the method clarifies some general points which are applicable to any more general relativistic extended model. (LBS)

8796 NON-DIFFRACTIVE MECHANISM IN MULTI-PARTICLE PRODUCTION PROCESSES. Morii, T. (Osaka Univ., Toyonaka, Japan); Noda, H. Progr. Theor. Phys. (Kyoto); 49: No. 6, 2141-2142(Jun 1973).

As a first step to clarify the production mechanisms of multiparticle reactions, the nondiffractive mechanism is investigated, which is specified by the non-Pomeron exchange based on the multi-Regge model. The magnitude of the t_1-cut and the quality of effective trajectories are determined. (LBS)

8797 DIFFRACTIVE MECHANISM IN MULTI-PARTICLE PRODUCTION PROCESSES. Morii, T. (Osaka Univ., Toyonaka, Japan); Noda, H. Progr. Theor. Phys. (Kyoto); 49: No. 6, 2143-2145(Jun 1973).

The diffractive mechanism and its structure in multiparticle production processes are investigated. The role which the nondiffractive and diffractive mechanism play in the cross section of $\pi^-p \rightarrow \pi^-\pi^+\pi^-p$ interactions is examined. (LBS)

8798 COMPLETE SETS IN THE RELATIVISTIC LADDER SCHEME OF THE HADRON CLASSIFICATION. Nikolov, A. V. (Univ., Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 5, 611-613 (1973). (In Russian).

A mathematical study indicated that three-dimensional parity is maintained in all strong but not in all weak interactions, i.e., it is similar to ordinary parity. (auth)

8799 QUANTUM-FIELD FORMALISM OF THE NUCLEON-K_α-BOSON MODEL OF HADRONS. Kushnirenko, A. N. (Inst. of Problems in Materials Science, Kiev). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 11, 48-54(1972). (In Russian).

The dynamic tool of a new model of hadrons is the ordinary quantum theory of a field describing the behavior of a system of

interacting spin and pseudo-vector fields. Based on a nucleon-K_α-boson model of hadrons, a single theory of elementary particles can be built which includes the lepton theory. By this can be explained the whole combination of elementary particles with observation of the three-field system: unit spin-K_α boson-electromagnetic. The proposed lepton theory inherently explains the presence of two neutrinos; the proton, neutron, electron, muon, and both neutrinos are different states of unitary phenomena. An equation is presented which indicates that the field mass of the muon is generated by interaction of the muon with the vacuum of the electromagnetic field and with that of the K_α-boson field. Therefore the muon mass should be greater than the electron mass. The lepton theory considered explains the weak reaction occurring both with and without changes in singularity. Both weak and strong interactions are responsible for K_α-bosons. (tr-auth)

8800 PHENOMENOLOGY OF INCLUSIVE REACTIONS. Roberts, R. G. (Rutherford High Energy Lab., Chilton, Eng.). pp 119-208 of Proceedings of the Seventh Finnish Summer School in Physics, Loma-Koli, Finland, June 26-July 7, 1972. Pellinen, R. (ed.). Helsinki; Univ. of Helsinki (1972).

From seventh Finnish summer school in physics, modern developments in hadron physics; Loma-Loli, Finland (26 Jun 1972). See CONF-720693-.

Some salient features of multiparticle production are pointed out. The choice of variables together with the kinematics of inclusive interactions are then discussed. The conjectures of scaling and limiting fragmentation are next discussed. It is then shown how Regge phenomenology has been applied to inclusive interactions, exploiting the generalized optical theorem to its fullest. Finally, various dynamical models for n-particle amplitudes are studied in the context of inclusive interactions. (LBS)

8801 STATISTICAL AND DYNAMICAL PROPERTIES OF DUAL RESONANCES. Gorenshtein, M. I.; Zinov'ev, G. M.; Miranskii, V. A.; Struminskii, B. V.; Shelest, V. P. (Inst. of Theoretical Physics, Kharkov). Yadern. Fiz.; 18: No. 5, 1122-1132(Nov 1973). (In Russian).

The dual resonance model is considered from the statistical point of view. Averaged characteristics are calculated: the density of resonance states, average spin, total and partial decay widths for heavy resonances. The obtained results enable one to consider the dual model as a dynamical realization of basic conceptions of the statistical bootstrap theory. A new type of averaging is introduced that takes into account many properties of strong interaction dynamics. A qualitative discussion of possible mechanisms of hadron generation in high-energy collisions is presented. (auth)

8802 ELECTROMAGNETIC CONTRIBUTIONS TO TOTAL HADRON CROSS SECTIONS AT HIGH ENERGIES. Budnev, V. M.; Ginzburg, I. F. (Mathematics Inst., Novosibirsk, USSR). JETP Lett. (USSR) (Engl. Transl.); 18: No. 2, 77-79(20 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 2, 133-136(20 Jul 1973).

A large electromagnetic correction ($\sim\alpha\ \ln^2(s/s_0)$ can appear in processes with large multiplicity. This correction may explain the observed growth of the cross sections in ISR experiments. (auth)

8803 LIMITATION ON THE MASSES OF SUPERCHARGED HADRONS IN THE WEINBERG MODEL. Vainshtein, A. I.; Khriplovich, I. B. (Nuclear Physics Inst., Novosibirsk). JETP Lett. (USSR) (Engl. Transl.); 18: No. 2, 83-85(20 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 2, 141-145(20 Jul 1973).

Upper bounds on the mass of the supercharged quark, which follow from an analysis of the $K_L \to 2\mu$ decay and the K_L-K_S mass difference, are obtained within the framework of a weak-interaction scheme based on hadron SU(4) symmetry. (auth)

8804 INTERACTING-STRING PICTURE OF DUAL-RESONANCE MODELS. Mandelstam, S. (Univ. of California, Berkeley). Nucl. Phys., B64: No. 2, 205-235(1973).

Dual-resonance models are analyzed by means of operators which act within the physical Hilbert space of positive-metric states. The basis of the method is to extend the relativistic-string picture of Goldstone, Goddard, Rebbi and Thorn to interacting particles. Functional methods are used, but their relation to the operator formalism is evident, and factorization is maintained. An expression is given for the N-point amplitude in terms of physical-particle operators. For the three-point function the Neumann functions which occur in this expression are evaluated, so that a formula is obtained for the on- and off-energy-shell vertex. It is assumed that the string has no longitudinal degrees of freedom, and our results are Lorentz invariant and dual only if $d = 26$. (auth)

8805 ALTERNATIVE TO THE QUARK PARTON MODEL. Stech, B. (Univ., Heidelberg). Nucl. Phys., B64: No. 2, 194-204(1973).

A bound state description of hadrons is attempted using an interacting local spinor field. To obtain an early onset of scaling, this field is required to have sizeable matrix elements at relatively low energies and thus should carry conventional quantum numbers. Although this field is not an interpolating baryon field and does not correspond to particles of discrete mass, a parton picture results: form factors, equal time correlation and scaling functions are related by a hadron wave function. (auth)

Strong (Baryon No. = 0)

8806 (JINR-E2-7418) VERTEX PART ASYMPTOTIC PROPERTIES AND CUTKOSKY RULES. Frenkin, A. R.; Mineev, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

A new approach towards the study of the asymptotic properties of the perturbation theory Feynman amplitude is suggested. The method is based on the connection between the Feynman integral asymptotic properties and the unitary intersections (the Cutkosky rules). The asymptotic behavior of the vertex part for the case of scalar boson interaction is considered. Nevertheless, improved method is general and applicable for other types of interactions. In addition, a criterion for the asymptotic behavior is proposed. The approach suggested is illustrated by an example of the irreducible vertex amplitude of the fifth order. (auth)

8807 η-η' MIXING ANGLE. Han, S. J. (Univ. of Massachusetts, Amherst). Phys. Lett., 47B: No. 2, 169-170(29 Oct 1973).

The mixing angle of $\eta-\eta'$ is calculated based on the symmetry breaking model. The mixing angle is found to be $\theta = 10.4$ with $m_K = 1200$ MeV, while quadratic SU(3) mass formula gives $\theta = 10.3$. (auth)

8808 EXCHANGE DEGENERATE REGGE-POLE MODEL FOR np AND $p\bar{p}$ CEX SCATTERING. Pal, B. K. (University of California, Berkeley). Progr. Theor. Phys. (Kyoto), 49: No. 5, 1630-1641(May 1973).

One way to obtain the sharp peaks in the $np \to pn$ and $p\bar{p} \to n\bar{n}$ differential cross section data is to assume there are opposite parity partners of exchange-degenerate π- and B-meson trajectories. The residues of these parity doublets can be chosen so that physical partners of the π and B are absent. The invariant amplitudes, free from kinematic singularities, are constructed in Veneziano representation to show conspiracy relations in helicity amplitudes for isotopic spin $I = 0$ and $I = 1$ demanded by the forward peak in experimental $d\sigma/dt$. Since parity partners ρ and A_2 do not exist in nature, the usual Regge contribution due to exchange-degenerate ρ and A_2 exchange is employed, reducing thereby the number of parameters in residues and trajectories. The Veneziano-type t-dependent gamma function residue is introduced. (auth)

8809 QUESTIONS IN $\pi\pi$ SCATTERING AND RELATED PROCESSES. Morgan, D. (Rutherford High Energy Lab., Chilton, Eng.). pp 9-31 of Proceedings of the Seventh Finnish Summer School in Physics, Loma-Koli, Finland, June 26-July 7, 1972. Pellinen, R. (ed.). Helsinki; Univ. of Helsinki (1972).

From seventh Finnish summer school in physics, modern developments in hadron physics; Loma-Koli, Finland (26 Jun 1972). See CONF-720693-.

The current activity in the field of $\pi\pi$ scattering and related processes is illustrated. The lectures are divided as follows: survey of $\pi\pi$ scattering-experiment and theory; extracting $\pi\pi$ information from dipion production data; interferences from analyticity, crossing and unitarity; and inelastic channels and related processes. (LBS)

8810 $\rho-\omega$ INTERFERENCE IN KAONIC REACTIONS. Bramon, A.; Srivastava, Y. (CNEN, Frascati, Italy). Phys. Lett.; 47B: No. 3, 265-267(12 Nov 1973).

The unitary model for interfering resonances proposed by Earles and Srivastava is applied to $\rho-\omega$ production through kaon induced reactions and strange meson decays. Present data, such as they are, seem to favor this model over an incoherent sum of Breit-Wigner resonant form. (auth)

8811 IS THE OPTICAL THEOREM VIOLATED. Kupczynski, M. (Univ., Warsaw). Phys. Lett.; 47B: No. 3, 244-246 (12 Nov 1973).

The $\bar{p}p$, pp, π^+p, π^+d, K^+p and K^+d data are analyzed to check the hypothesis of the break of the optical theorem presented previously. (auth)

8812 DUAL PROPERTY OF DIFFRACTIVE RESONANCES FROM SEMILOCAL FACTORIZATION. Roberts, R. G.; Roy, D. P. (Rutherford High Energy Lab., Chilton, Eng.). Phys. Lett.; 47B: No. 3, 246-250(12 Nov 1973).

By semilocal factorization the ratio of diffractive resonance production cross sections on π and K should equal the ratio of π and K couplings to P(f) if the resonances are dual to Pomeron (normal meson) exchange. Experimental data favor the former. (auth)

8813 CRITICAL TEMPERATURE AND PAIRING IN PARTON MODELS. Ellam, G.; Gell, Y. (McGill Univ., Montreal). Phys. Lett.; 47B: No. 3, 255-257(12 Nov 1973).

The large gap observed in the meson spectrum between the first two SU (3) multiplets is attributed to pairing between partons. A critical temperature of 180 MeV is predicted through a universal relation derived in pairing theory. The absence of a large gap in the baryon system is explained. Consequences of the pairing hypothesis to 90° differential cross sections in the framework of a statistical parton model are also pointed out. (auth)

Strong (Baryon No. = 1)

8814 (LNF-73/47) $\rho-\omega$ INTERFERENCE IN KAONIC REACTIONS. Bramon, A.; Srivastava, Y. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). 30 Jul 1973. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

The $\rho-\omega$ interference in the $\pi^+\pi^-$ system produced either in $K^- + p \to \Lambda(\Sigma^0) + \pi^+ + \pi^-$ interactions or strange meson decays was studied. It was found that various models give quite different spectra. (JFP)

8815 FORMULATION OF CHARGE INDEPENDENCE OF THE PION–NUCLEON INTERACTION. Breit, G. (State Univ. of New York, Buffalo). pp 143-167 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

Problems involved in the formulation of charge independence of the πN interaction in the OPE picture are discussed. The role of the pion mass difference is also discussed. (LBS)

8816 RADIUS MODEL OF BARYON COUPLINGS. Kamath, S. G.; Mitra, A. N. (Univ. of Delhi). Phys. Lett.; 47B: No. 2, 155-158(29 Oct 1973).

A simple model for the coupling of the baryon trajectories $N_{\alpha,\gamma}$, Δ_δ, $\Lambda_{\alpha,\gamma}$, $\Sigma_{\Delta,\delta}$ based on a fixed radius of the interaction is shown to exhibit some remarkable regularities in the decay spectra of these trajectories, and also to respect the requirement of EXD at the supermultiplet (L) level. A slight variant of the model to take account of retardation due to momenta, also gives a reasonably good description of the data with the additional promise of showing dips in CEX reactions. (auth)

8817 ENERGY-DEPENDENCE OF BACKWARD PEAKS IN HADRON SCATTERING. Barnhill, M. V.; Kilgren, L. M. (Univ. of Delaware, Newark). Phys. Lett.; 47B: No. 2, 159-161(29 Oct 1973).

The general trend of the energy dependence of the backward peaks in certain meson-baryon elastic scattering cross sections has been fit using information obtained from forward scattering and a specific quark-model mechanism. (auth)

8818 NON-LINEAR π-B EXCHANGE-DEGENERATE REGGE TRAJECTORY. Kawaguchi, T.; Kugo, T.; Sasabe, S.; Bando, M. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2021-2030(Jun 1973).

It is shown that the nonlinear π-B exchange degenerate trajectory reproduces very well the experimental data of $\rho^0_{00}d\sigma/dt$ for $\pi N \to \omega N(\rho N)$ processes. The value of the slope near $|t| \approx 0$ is almost twice as large as ordinary ones, and seems to approach the ordinary slope $\alpha' \approx 1$ $(GeV/c)^{-2}$ for large $|t|$ values. (auth)

8819 PRODUCTION CROSS SECTION OF $\pi N \to \pi N^*$ AND SU(6) ⊗ O(3)STRUCTURE. Hirano, M.; Iwata, K.; Matsuda, Y.; Murota, T. (Hokkaido Univ., Sapporo). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2047-2070(Jun 1973).

Under the approximation of the additivity and the factorizability, $(d\sigma/dt)(\pi N \to \pi N^*)$ and the N^* spin-density matrix are expressed by the πN elastic scattering amplitudes and the SU(6) ⊗ O(3) wave functions of N and N^*. Using this expression, at first, relations between $(d\sigma/dt)(\pi N \to \pi N^*)|_{t=0}$ and the partial decay width $\Gamma(N^* \to N\pi)$ which contain only measurable quantities and depend only on the general SU(6) ⊗ O(3) structures are derived. These relations are consistent with experiment and suggest the validity of the SU(6) ⊗ O(3) structure of N and N^* and the approximations of the additivity and the factorizability. Secondly, by adopting the harmonic oscillator wave function as a model of the O(3) structure, one gets $d\sigma/dt$ of L-excited N^*. The quantity $\alpha = 0.63$ GeV is taken as the value of the harmonic oscillator parameter which has been determined by the previous analysis of Γ_{N^*}. Therefore no adjustable parameter remains. The model agrees fairly well with experiment. The agreement becomes better if the result of the harmonic oscillator model is multiplied by a correction factor $\Gamma_{exp}/\Gamma_{cal}$. A prediction of $(d\sigma/dt)(\pi N \to \pi N^*)$ is given for N_α ($\frac{5}{2}^+$, 2220) and N_γ ($1\frac{1}{2}^-$, 2650) by this method. Lastly the model wave function of N(1470) which is regarded as a radially excited state is discussed. (auth)

8820 TOTAL DECAY WIDTHS OF RESONANCE AND REGGE TRAJECTORIES. Kobayashi, R. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2037-2046(Jun 1973).

The compatibility of the imaginary parts of baryon Regge trajectories $\alpha(u)$ with the almost linearly rising feature of $Re\alpha(u)$ is investigated. Corrections to $Re\alpha(u)$ due to nonvanishing $Im\alpha(u)$, which is estimated from the total decay widths of resonances lying on the leading trajectories, are calculated in a phenomenological way through dispersion relations with unitarity cuts only. It is found that $Im\alpha(u)$ must decrease when u becomes large in order to maintain the deviation of $Re\alpha(u)$ from linearity small in the low energy region. A brief discussion on meson trajectories is also presented. (auth)

8821 SEARCH FOR SATURATION OF ISOSPIN BOUNDS AND ISOSPIN ANALYSIS OF $\pi N \to K\Sigma$ AND $\bar{K}N \to \pi\Sigma$. Korkea-Aho, M.; Toernqvist, N. A. (Univ. of Helsinki). Nucl. Phys., B64: No. 2, 464-477(1973).

By performing an isospin analysis of $\pi N \to K\Sigma$ and $\bar{K}N \to \pi\Sigma$ it is found that the isospin bounds are satisfied as equalities (or slightly violated) in three regions (i) at $\theta = 0°$ in both reactions at all energies studied, (ii) for small forward angles in $\pi N \to K\Sigma$ above 1.7 GeV/c, (iii) near $\theta \simeq 90°$ between 600 and 800 MeV/c in $\bar{K}N \to \pi\Sigma$. In $\pi N \to K\Sigma$ the analysis indicates that a different set of high mass (> 2 GeV) resonances dominate in the $K\Sigma$ channel than those known from $\pi N \to \pi N$. (auth)

8822 RESULTS OF NUMERICAL TESTS ON THE UNIQUENESS OF THE πN PHASE SHIFTS. Berends, F. A. (Leiden Univ.). Nucl. Phys., B64: No. 2, 236-243(1973).

A partial answer to the uniqueness question of the existing πN phase shifts is given. Specifically, one of the existing sets of partial wave amplitudes is chosen and a numerical search is made for other sets of partial waves, which have the same number of waves and which give the same differential and total cross section, and polarization as the original one. At least up to the centre-of-mass energy of 2025 MeV no such set of phase-shifts is found. (auth)

8823 MODEL INDEPENDENT CALCULATION OF Kp DISPERSION RELATIONS: EXTRAPOLATION WITH PADE TECHNIQUES. Lopez, C.; Yndurain, F. J. (Univ. Autonoma de Madrid). Nucl. Phys., B64: No. 2, 315-333(1973).

The methods of the moment problem and Padé approximants are used to extrapolate forward Kp dispersion relations. Reliable estimates are obtained for the effective (Λ,Σ) coupling constant, and averages of the absorptive part of the scattering amplitude over the unphysical cut. The results are applied to calculate the constant phase curves for F_{Kp}, the zeros of this amplitude, and the Adler-Weisberger relation for the kaons. (auth)

8824 πN AMPLITUDES AT LARGE MOMENTUM TRANSFER. Elvekjaer, F.; Inami, T.; Phillips, R. J. N. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Phys., B64: No. 2, 301-314(1973).

The πN amplitudes are estimated from data in the region $0.8 \leq |t| \leq 1.4$ $(GeV/c)^2$ for incident momentum between 3.7 and 14 GeV/c, under the assumption of ρ-Regge-pole phase for the $I_t = 1$ s-channel helicity flip amplitude. The main conclusions are: (i) the real part of the $I_t = 0$ non-flip amplitude is substantial and its non-asymptotic variation with energy has not died out, (ii) the $I_t = 1$ non-slip amplitude shows a large degree of shrinkage as energy increases out to $t = -1.4$ $(GeV/c)^2$, (iii) the $I_t = 1$ non-flip amplitude has a second cross-over zero at $t \simeq -1.2$ $(GeV/c)^2$ in its imaginary part. (auth)

8825 VENEZIANO MODEL FOR THE REACTION $\pi^-p \to \pi^+\pi^-n$. Lavelle, J. W.; Wong, D. Y. (Univ. of California, San Diego, La Jolla). Nuovo Cim., 18A: No. 3, 574-591(1 Dec 1973).

A generalization of the one-pion exchange model for the reaction $\pi^-p \to \pi^+\pi^-n$ in the resonant $\pi\pi$ region is developed by means of the five-point function of Bardakci and Ruegg. The model, using the slope of the pion trajectory as the only adjustable parameter, has appropriate spin content and proper Regge behavior. A K-matrix unitarization scheme for mesons, generalized for the production process, was used. The model is applied over a wide range of energies, and variations of all four remaining independent variables are also examined. The results are in general agreement with experiment, suggesting that the formulation is a desirable improvement over previous phenomenological models. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstract 8859.

8826 (COO-1764-188) REGGE TRAJECTORIES AND THE QUARK-GLUON COUPLING CONSTANT. Coon, D. D.; Suura, H. (Minnesota Univ., Minneapolis (USA); Pittsburgh Univ., Pa (USA)). 1973. Contract AT(11-1)-1764. 8p. Dep. NTIS $3.00.

It is argued that vector gluons interacting with quarks produce logarithmic behavior of Regge trajectories at large momentum transfer in agreement with proton-proton scattering data. It is found that $g^2/4\pi = 14$ where g is the gluonic charge (charm) of the quarks. Some suggestive relations between quark-gluon dynamics, duality magnetic charge and Jacobi's imaginary transformation are discussed. (auth)

8827 (JINR-E2-7369) STUDY OF THE ENHANCEMENTS IN THE Λp INVARIANT MASS SPECTRUM IN $\pi^{-12}C \to \Lambda p\, K(n\pi)^{10}B$ INTERACTION AT 4 GeV/c. Chlebowska, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

The Λp invariant mass spectrum for the reaction $\pi^{-12}C \to \Lambda p\, K(n\pi)^{10}B$ is calculated assuming the triangle diagram interaction with the two-nucleon clusters. The low energy Λp scattering peak at 2058 MeV and the resonant peaks at 2127 and 2252 MeV Λp center of mass energy are obtained. An enhancement at about 2158 MeV corresponding to the $\Sigma N \to \Lambda p$ conversion process can appear. (auth)

8828 (JINR-P2-7462) ELECTROMAGNETIC INTERACTIONS AND THE INCREASE OF TOTAL HADRON CROSS SECTIONS AT HIGH ENERGIES. Kopeliovich, B. Z.; Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The electromagnetic and strong interaction interference is discussed in connection with increasing the p-p total cross section σ_{tot}^{pp}. It is shown that the part of the cross section due to photon-vector meson exchange interferences is increased as ln s. A few purely electromagnetic reactions with raising cross sections are described. Their energy-dependent part contribution is much smaller than the experimentally observed increase. It is shown by means of complex angular momentum methods that there are the interference terms in the σ_{tot} which are increased with energy as ln s. The masses of two particle showers are large enough that the chain of equalities takes place. Here r_1 is the Regge pole, Im means the imaginary part of the forward scattering amplitude $\gamma p \to pp$. From the Gribov reggeon calculus it follows that to γ-r_1 loop on the diagram corresponds singularity $\ln(j-\alpha_{r_1})$. So, two-particle unitarity in the t-channel gives the partial amplitude. If r_2 is a pomeron, the interference contribution to σ_{tot} is increased as ln s. A similar consideration in the one shower process leads to asymptotically constant interference contribution. It is worthwhile noting that nondecreasing interference mechanisms do not violate the Pomeranchuk theorem, and the relative value of the σ_{tot} increase does not depend upon the nature of scattering particles. The detailed calculation of the Feynman diagram is fulfilled. If the ρ-meson is treated as an elementary particle the γ-ρ exchanges interference contribution to the σ_{tot} is described, where the t-momentum transfer squared, S_1, S_2 are shower masses squared, $-t_m = S_1S_2/S$. The reggesation is carried out under the following requirements: if $t \to m_\rho^2$, the reggezation formula should turn the given one; the particles are produced in multiperipheral chain; the last particles in the two chains, which are connected with the exchanged ρ-meson, are π-mesons; the Veneziano model for residue is chosen. By adding the contributions from ω- and ρ-meson exchanges it is found that in the energy interval IHEP-ISR interference adds to σ_{tot}^{pp} about 1 mb. So, this effect is remarkable. (auth)

8829 (LBL-2175) THRESHOLD EFFECTS AND OSCILLATIONS IN MODELS WITH t-CHANNEL FACTORIZATION. Koplik, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 26 Sep 1973. Contract W-7405-eng-48. 15p. (CONF-730837-8). Dep. NTIS $3.00.

From meeting of the division of particles and fields; Berkeley, California, USA (13 Aug 1973).

Threshold effects and oscillating cross sections are reviewed in the context of models (such as the multiperipheral) which employ factorization and indefinite repetition in the t-channel. The origin of logarithmic energy thresholds is illustrated by the ABFST model and applied to antibaryon production and rising cross sections at high energy. Then one discusses large-mass diffraction dissociation and it is argued that this process is not responsible for the increase in the p-p total cross section at ISR energies. (auth)

8830 NUCLEON–NUCLEON SCATTERING AMPLITUDE IN THE FIRST DIAGONAL PADE APPROXIMATION AND THE RATIO G_A/G_V IN THE FRAMEWORK OF SU_2 SIGMA MODEL. Khelashvili, A. A. (Tbilissi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 71: No. 1, 85-88(Jul 1973). (In Russian).

Considering the [1,1] Padé approximant of the NN-scattering amplitude near the π-meson pole the relation between the ratio G_A/G_V and an effective πN-interaction constant is established, which is in good agreement with the experimental data. The derived result is valid in one-loop approximation of the perturbation theory in the linear SU_2 sigma model as well as in the nonlinear one. (auth)

8831 MULTIPLICITY DISTRIBUTIONS AND INCLUSIVE SPECTRA IN A MULTIPERIPHERAL CLUSTER EMISSION MODEL. Berger, E. L. (CERN, Geneva); Fox, G. C. Phys. Lett.; 47B: No. 2, 162-168(29 Oct 1973).

A simple two-parameter model incorporating pion clusters produced with a multiperipheral-like matrix element is proposed. It gives a good qualitative description of multiplicity, and of single- and two-particle rapidity distributions above 50 GeV/c. (auth)

8832 PHENOMENOLOGICAL INVESTIGATION OF THE POMERON IN pp SCATTERING. Collins, P. D. B.; Gault, F. D.; Matin, A. (Univ. of Durham, Eng.). Phys. Lett.; 47B: No. 2, 171-176(29 Oct 1973).

An attempt was made to fit the pp scattering data for $10 < s < 3000$ GeV^2 with a variety of models using a Pomeron pole (P) and associated cuts. It is found that $\alpha_P(0) > 1$, but no cuts, gives much the best fit, the dip at $|t| \approx 1.4$ GeV^2 and the large $|t|$ behavior stemming instead from a non-shrinking "core" term. (auth)

8833 ANGULAR DISTRIBUTION OF p–p ELASTIC SCATTERING AT HIGH ENERGIES AND DISTRIBUTION OF ABSORPTION. Nagasaki, M. (Rikkyo Univ., Tokyo); Taketani, M. Progr. Theor. Phys. (Kyoto); 49: No. 6, 2145-2147(Jun 1973).

It was previously shown that the breaks or minimum at $|t| \approx 1.3$ (GeV/c)^2 observed in the experimental angular distribution of pp elastic scattering at 10 to 24 GeV/c can be explained by a rather simple distribution of the absorption surrounding a hard core. Corrections are made to the distribution of the absorption, which give the correction to the scattering amplitude and to the total cross sections. The conclusion given of the trend of the variation of the radius of the hard core versus the incident momentum remains unaltered. (LBS)

8834 TWO-PARTICLE CORRELATION BASED ON MULTIPERIPHERAL AND DIFFRACTIVE PRODUCTION MECHANISMS. Kagiyama, S. (Fukuoka Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2031-2036(Jun 1973).

The coexistence of multiperipheral and diffractive production mechanisms fairly explains energy dependence of average multiplicity of negative charged particles $\langle n^- \rangle$, the Mueller correlation parameter f_2 and inelastic cross section $\sigma_{tot}^{inel}(s)$ in pp interaction at 10 ~ 1000 GeV/c. Structures in energy dependence of $\sigma_{tot}^{inel}(s)$ and $\langle n^- \rangle$ are also predicted. Such behaviors are consistent with recent experiments of the NAL and ISR. (auth)

8835 EXCITED STATES OF p-SHELL HYPERNUCLEI. Kochetov, A. B.; Khrylin, B. A. (Moscow Inst. of Radio, Electronics, and Automation). JETP Lett. (USSR) (Engl. Transl.); 18: No. 2, 79-80(20 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 2, 136-138(20 Jul 1973).

The excitation energies of p-shell hypernuclei with ΛN potentials having strong repulsion in odd states are calculated. (auth)

8836 MULTIPLICITY SCALING AT LOW ENERGIES, A GENERALIZED WROBLEWSKI FORMULA AND THE LEADING PARTICLE EFFECT. Buras, A. J.; Dias De Deus, J.; Moller, R. (Univ. of Copenhagen). Phys. Lett.; 47B: No. 3, 251-254(12 Nov 1973).

The use of a scaling variable $z' = (n - \alpha)/(\langle n \rangle - \alpha)$ with α being constant provides an extension of the KNO scaling to

low energies. A generalized Wroblewski formula to higher moments $\sqrt[N]{\langle(n-\langle n\rangle)^N\rangle} = K_N\langle n\rangle - K_N\alpha$ is obtained. One tentatively connects α with the leading particle effect. (auth)

8837 RELATIVISTIC DEUTERON WAVEFUNCTIONS. Hornstein, J.; Gross, F. (Coll. of William and Mary, Williamsburg, VA). Phys. Lett.; 47B: No. 3, 205-208(12 Nov 1973).

A relativistic description of deuteron structure requires four wave functions: the usual S- and D-state functions and two purely relativistic P-state wave functions. A calculation of the P-state wave functions is described; their combined probability is approximately ½%. (auth)

8838 $\Delta N \rightarrow NN$ INTERACTION. Karmanov, V. A.; Kondratyuk, L. A.; Leksin, G. A.; Khasanov, F. M. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 5, 1133-1139(Nov 1973). (In Russian).

The experimental data on the processes $p + p \rightarrow p + n + \pi^+$ and $p + p \rightarrow p + p + \pi^0$ are used to obtain the cross section of the reaction $\Delta^- + p \rightarrow n + n$ in the kinetic energy region of the incident isobar from 10 MeV to 27 GeV. The results are satisfactorily described by the one-pion-exchange model. The contributions from ΔN rescattering in the initial state and from NN rescattering in the final state are estimated. The found length of the interaction $\Delta^- p \rightarrow nn$ and form factor of the transition $\Delta \rightarrow \pi N$ can be used in the analysis of the data on incoherent Δ-production of nuclear targets. (auth)

8839 HIGH ENERGY PROTON-PROTON TOTAL CROSS SECTION AND COSMIC-RAY DATA. Auger, J. P. (Laboratoire de Physique, Orleans Cedex, France); Lombard, R. J. Phys. Lett.; 47B: No. 3, 261-264(12 Nov 1973).

Proton-nucleus total inelastic cross sections were calculated in the multiple scattering theory for incident proton energies ranging between 20 and 10^5 GeV. The results are compared to available cosmic-ray data. In view of the present analysis, extrapolations of the latest I. S. R. results on the proton-proton total cross section σ according to a logarithmic law almost saturating the Froissart bound seem hazardous. (auth)

8840 PRODUCTION OF PARTICLES WITH LARGE TRANSVERSE MOMENTA IN THE PIONIZATION REGION. Levin, E. M.; Ryskin, M. G. (Leningrad Inst. of Nuclear Physics). Yadern. Fiz.; 18: No. 5, 1108-1113(Nov 1973). (In Russian).

Inclusive cross section for production of π mesons with large transversal momenta, calculated in multiperipheral $\lambda\varphi^3$ and parton model, $\omega_c d\sigma/d^3q_c = f(q_{tc}, s) \sim q_{tc}^{-8}$, is in a reasonable agreement with the experiment. It is shown that a large $q_{tc}f(q_{tc}, s)$ depends essentially on the energy of the colliding protons, $f(q_{tc}, s) \sim q_{tc}^{-8}(1-2q_{tc}/\sqrt{s})^6$. A possibility to explain the experimental data by means of the multiperipheral model, constructed of conventional particles, is discussed: correlations between two π mesons with large transverse momenta are predicted. (auth)

8841 ONE-PARTICLE DISTRIBUTION IN DAMA. Jenkovszky, L. L.; Kobylinsky, N. A.; Martynov, E. S. (Inst. of Theoretical Physics, Kharkov). Yadern. Fiz.; 18: No. 5, 1114-1121(Nov 1973). (In Russian).

One-particle distribution in various asymptotic limits are studied in the framework of DAMA (dual amplitude with Mandelstam analyticity). The predictions in the central region essentially differ from those obtained in the narrow resonance Veneziano model, while experimental data support the predictions of DAMA. The differences in other limits are less important. (auth)

8842 DECOMPOSITION OF THE INTERCEPT OF A REGGE TRAJECTORY ACCORDING TO MULTIPLICITIES OF PRODUCED PARTICLES: COMPARISON WITH pp DATA AT ISR ENERGIES. Suzuki, M. (Univ. of California, Berkeley). Nucl. Phys., B64: No. 2, 486-492(1973).

The average multiplicities of the particles produced through pionization are related directly to how the intercept of the pomeranchuk Regge pole is composed of different hadrons. Comparison with the pp collision data at ISR energies indicates, with some additional dynamical assumptions, that the pomeron intercept at $t = 0$ is made mainly of pions ($\simeq 67\%$) and of $K\bar{K}$ and $N\bar{N}$ pairs ($\simeq 17\%$ each within large errors). The sharply rising $N\bar{N}$ pair component may raise the intercept above unity so as to cause superficial violation of the Froissart bound transiently. (auth)

8843 LEADING PROTON EFFECT IN PROTON-PROTON COLLISIONS. Gabarro, J.; Pajares, C. (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucl. Phys., B64: 493-498(1973).

The p spectrum data in the range $s = 28$ to $s = 1995$ are described with the triple Regge formula. The behavior of the various couplings at small $|t|$ is explored. It is found that the non-scaling terms, at $s \simeq 400$ GeV^2 remove the turnover expected if the triple pomeron vanishes at $t = 0$. The results are discussed in connection with the expected behavior of the terms in several models. (auth)

8844 DIBARYON RESONANCE PRODUCTION IN pp SCATTERING. Bhasin, V. S.; Duck, I. M. (Rice Univ., Houston, TX). Nucl. Phys., B64: No. 2, 289-300(1973).

The angular distributions of negative pions produced in proton-proton collisions in the energy range of one to four GeV bombarding energy are calculated assuming the production of a low energy dibaryon resonance between the $\Delta(1236)$ and a proton. Triangle amplitudes involving $\pi^0 p \rightarrow \pi^-\Delta^{++}$ and $\pi^- p \rightarrow \pi^- p$ plus pion exchange, evaluated in the Yao-Barry approximation, dominate the Δ-exchange amplitude and produce differential cross sections comparable to those for $pp \rightarrow \pi d$. (auth)

8845 MODEL ANALYSIS OF THE LPS DISTRIBUTIONS FOR THE PROCESS $pp \rightarrow p\pi^-\Delta^{++}$. Humble, S. (Daresbury Nuclear Physics Lab., Warrington, Eng.). Nucl. Phys., B64: No. 2, 349-371(1973).

The LPS distributions for the process $pp \rightarrow p\pi^-\Delta^{++}$ are studied at 5, 8, 19 and 25 GeV/c incident proton momentum in terms of simple models. It is found that the shape of these distributions together with their energy dependence provide severe constraints on the possible dynamical mechanisms. For instance although there is evidence for pion exchange it is observed that a large leading meson exchange contribution must also be present in this reaction. As a result of the model considerations it is suggested that the flat LPS distribution corresponding to baryon exchange and low-mass ($p\Delta^{++}$) production may be a feature of other reactions with a similar exotic subsystem. Moreover in view of certain ambiguities in the model fits, a new two dimensional plot is proposed which explicitly displays the angular dependence of a sub-system as well as the principal exchange mechanisms. (auth)

8846 VENEZIANO MODEL FOR LOW-ENERGY NUCLEON-NUCLEON PHASE-SHIFTS AND HIGH-ENERGY CHARGE-EXCHANGE CROSS-SECTIONS. Stowe, K. S. (California State Polytechnic Coll., San Luis Obispo); Wong, D. Y. Nuovo Cim., 18A: No. 3, 427-444(1 Dec 1973).

A phenomenological model is constructed for low-energy nucleon-nucleon scattering ($\lesssim 400$ MeV) and high-energy np and $p\bar{p}$ charge-exchange scattering ($\gtrsim 5$ GeV) based on the Veneziano representation. The major advantage of the Veneziano representation vs. the usual OBE models for low-energy phase-shift calculations is that it provides a natural no-cut-off model. It is found that the S-waves and the higher partial waves can be reproduced with comparable accuracy using the N/D method with four adjustable parameters. These are the two ρ-meson coupling constants, the ϵ-meson coupling constant and the coupling constant of a pion conspirator. Although the conspirator coupling has little effect on the low-energy phase shifts, its existence is demanded by the self-consistency of the Veneziano representation. At high energies, the conspirator plays an essential role in reproducing the forward peak in charge-exchange scatterings. However, the data indicate that it is necessary to suppress the ρ contribution and introduce a phase factor differing from that of the simple Veneziano model. A two-parameter modification of the ρ trajectory along with the given π and π conspirator trajectories yields a satisfactory fit to both the np ((5 to 24) GeV) and the $p\bar{p}$ ((6 to 9) GeV) data. (auth)

8847 INCLUSIVE PRODUCTION AT LARGE MASS AND LARGE TRANSVERSE MOMENTUM. Greco, M. (CERN, Geneva); Srivastava, Y. N. Nucl. Phys.; B64: No. 2, 531-543 (1973).

Production of massive lepton pairs in hadronic collisions is discussed in a model recently proposed by us (with E. Etim) which shows scaling for strong as well as e. m. processes and an increase in the average transverse momentum with the mass. Next this model is applied to obtain approximately a $p_\perp^{-4}$ decrease with transverse momentum, $p_\perp$, in inclusive hadronic distribution functions. (auth)

8848 INFLUENCE OF REALISTIC DEUTERON WAVE FUNCTIONS ON NEUTRAL PION PHOTOPRODUCTION CROSS SECTIONS. Srinivasa Rao, K. (Inst. of Mathematical Sciences, Madras); Parthasarathy, R.; Devanathan, V. J. Physiol. (Paris); 34: No. 8, 683-686(Aug 1973).

The differential cross section for neutral pion photoproduction from deuterium, near the first resonance region, at fixed momentum transfer, is studied using realistic deuteron wave function and the results are compared with recent experimental data from Orsay. (FR)

Particle Invariance Principles and Symmetries

General

8849 STOCHASTIC SYMMETRY BREAKING OF TIME REVERSAL INVARIANCE. Fox, R. F. (Georgia Inst. of Tech., Atlanta). J. Math. Phys. (N. Y.); 14: No. 9, 1187-1189(Sep 1973).

An equation for the time evolution of the density matrix for a nonrelativistic quantum mechanical system is presented. It involves a Hamiltonian which contains a stochastic contribution. Before stochastic averaging is performed, it is shown that the density matrix equation is time reversal invariant, whereas after stochastic averaging is performed, it is shown that the averaged density matrix equation is not time reversal invariant. (auth)

8850 STRUCTURE OF ALISAUSKAS–JUCYS FORM OF THE 9j COEFFICIENTS. Wu, A. C. T. (Univ. of Michigan, Ann Arbor). J. Math. Phys. (N. Y.); 14: No. 9, 1222-1223(Sep 1973).

From the Ališauskas–Jucys triple summation expression, the Wigner 9j coefficients may be visualized as boundary values of a new generalized hypergeometric function $\phi^{(3)}$ $(\alpha_{jk}; \beta_k, \gamma_m; w_h)$ in three variables. Integral representations are given both for $\phi^{(3)}$ in general and its boundary values as the 9j coefficients. The Radon structure is discussed. It is seen that $\phi^{(3)}$ and the 9j coefficients in general do not belong to the class of hypergeometric functions whose Radon transforms are products of linear forms. (auth)

8851 SYMMETRY OF THE PHENOMENOLOGICAL LAGRANGIAN AND THE ADLER PRINCIPLE. Pashnev, A. I. (Kharkov State Univ.). Teor. Mat. Fiz.; 17: No. 2, 210-220 (Nov 1973). (In Russian).

Method of obtaining the soft-pion theorems starting from the phenomenological Lagrangian with the symmetry group G is proposed. The assumption is made that the Lagrangian includes arbitrary powers of particle momenta. The relationships obtained turn into the Adler conditions of self-consistency, if the restriction by lowest powers of field derivatives is made. The equivalence between the requirement of the symmetry of the Lagrangian and the Adler principle is proved. (auth)

8852 QUANTISED DE SITTER SPACE AND THE CONNECTION TO THE PAULI PRINCIPLE. Ulmer, W. (Univ., Stuttgart). Int. J. Theor. Phys.; 8: No. 1, 1-10(1973).

It is shown that the introduction of a fundamental length l_0 permits the definition of commutator rules between different observation systems, represented by the Poincaré groups. This fact leads to the model of a quantized De Sitter space, and the formulation of a nonlocal quantum field theory is obtained. The Dirac spinors are derived from the invariance of the quadratic form, defining De Sitter groups, and a connection to Pauli's exclusion principle can be understood by the same reason of a quantized space. A description of the structure of elementary particles involves a particular importance of the group SU(3). (auth)

8853 MENACE OF SU(9) DEGENERACY IN GAUGE THEORIES WITH COLOURED TRIPLETS. Dolgov, A. D.; Okun, L. B.; Zakharov, V. I. (Inst. for Theoretical and Experimental Physics, Moscow). Phys. Lett.; 47B: No. 3, 258-260(12 Nov 1973).

The gauge theories with colored triplets require SU(9) or SU(9) × SU(9) in contradiction with experiment. These higher symmetries can be broken to SU(3) × SU(3)′ only at a price of introducing a large number of new particles and still the masses of colored particles cannot be too high. (auth)

8854 ALGEBRAIC REALIZATIONS OF SYMMETRY AT HIGH ENERGIES. Noga, M. (Comenius Univ., Bratislava). Nucl. Phys.; B64: No. 2, 372-396(1973).

Interpolating fields of two vector and one scalar bosons are assumed to be related to the partial conservation of tensor and vector currents respectively. Equal time algebra between time dependent charges of these currents is assumed to be isomorphic to equal time algebra of broken conformal group symmetry. It is shown by employing the methodology of Weinberg's program for algebraic realizations of symmetry that the forward scattering amplitudes exhibit group symmetry at very high energies. This symmetry group is isomorphic to the conformal group. Matrix elements of time dependent charges taken between single particle states at high energies tend to matrix elements of group generators without any assumptions on how the symmetry is broken down. The structure of symmetry breaking is uniquely determined. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstract 8789.

8855 FUNDAMENTAL INTERACTIONS. Kursunoglu, B. (Univ. of Miami, Coral Gables, FL). pp 19-54 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

The ideas of symmetry and in particular of broken symmetries in the analysis of the basic states of matter are discussed. The photon, weak and strong interactions, and weak coupling of leptons and hadrons are treated in detail. (LBS)

8856 HADRON PHYSICS THROUGH ASYMPTOTIC SU(3) AND THE CHIRAL SU(3) × SU(3) ALGEBRA. Oneda, S. (Univ. of Maryland, College Park); Matsuda, S. pp 175-181 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

The inter-SU(3)-multiplet regularities and clues to a possible level scheme of hadrons are studied in a systematic way. The hypothesis of asymptotic SU(3) is made in the presence of GMO mass splittings with mixing, which allows information to be extracted from the chiral SU(3) × SU(3) charge algebras and from the exotic commutation relations. For the ground states the schemes obtained are compatible with those of the SU(6) × O(3) classification. Sum rules are obtained which recover most of the good results of SU(6). (LBS)

Applications (Strong)

8857 (COO-1764-190) FURTHER EVIDENCE FOR A 70, L = 2 BARYON MULTIPLET. Faiman, D.; Rosner, J. L.; Weyers, J. (European Organization for Nuclear Research, Geneva (Switzerland); Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 28 Feb 1973. 27p. Dep. NTIS $3.50.

The recently discovered f wave dominance of the decay $F_{35}(1877) \to \Delta\pi$ is interpreted as requiring mixing between 56, L = 2 and 70, L = 2 baryon multiplets. This conclusion is drawn in the context of a broken version of SU(6)$_W$. Further predictions include the existence of a second prominent F_{15} πN resonance around 2 GeV in mass and the more probable dominance of the 1.9 GeV enhancement seen in $\pi^+p \to \Sigma^+(1385)K^+$ by P_{33} and P_{31} rather than F_{37} or F_{35} resonances. (auth)

8858 (ORO-3992-93) BROKEN SU(4) ⊗ SU(4) SYMMETRY AND η–X mixing. Dicus, D. A.; Mathur, V. S. (Texas Univ., Austin (USA). Center for Particle Theory). Sep 1973. Contract AT(40-1)-3992. 13p. (CPT-147). Dep. NTIS $3.00.

Starting with chiral SU(4) ⊗ SU(4) symmetry of strong interactions, the implications of explicit symmetry breaking terms that transform as the (4,4*) ⊕ (4*,4) representation are discussed. In particular, the η–X mixing problem is studied. (auth)

8859 BROKEN CONFORMAL SYMMETRY. II. SINGLE-PARTICLE DISTRIBUTIONS IN INCLUSIVE REACTIONS. Yunn, B. C.; Koevesi-Domokos, S.; Domokos, G. (John Hopkins Univ., Baltimore). Nuovo Cim.; 18A: No. 3, 532-550(1 Dec 1973).

Single-particle distributions in inclusive hadronic reactions at high energies and large momentum transfers are investigated in the framework of broken conformal invariance. As a consequence of conformal invariance, the cross sections are shown to exhibit a partonlike structure. The cross sections obey simple scaling laws; presently available experimental data on the reaction $pp \to \pi^0X$ support this conclusion. It is predicted that the inclusive production rate of "heavy" particles (K, η) relative to pions is a slowly increasing function of the energy. The dependence of the cross section on the momentum transfers is evaluated within the framework of a simple model; the predicted distributions are in good agreement with the data. (auth)

Scattering Theory

Refer also to abstract 8915.

8860 (COO-1764-193) ASYMPTOTIC BEHAVIOR OF TRAJECTORY FUNCTIONS AND SIZE OF CLASSICAL ORBITS. Chang, S. J.; Rosner, J. L. (Institute for Advanced Study, Princeton, N. J. (USA)). 1972. Contract AT(11-1)-2220. 19p. (COO-2220-9). Dep. NTIS $3.00.

The strong-coupling limits of several ladder-graph models are explored. A correlation is found between the power of the coupling constant appearing in the leading Regge trajectory $\alpha(t = 0)$ and the size of classical orbits described by the coordinate-space Bethe-Salpeter wave function. Specifically, for the ϕ^3 theory with exchanged mass $m \neq 0$, the orbit radius r_0 approaches a fixed value, and $\alpha\ (t = 0) \sim g^4$; for ϕ^3, $m = 0$, r_0 grows linearly with g and $\alpha(t = 0) \sim g$; for ϕ^4, $r_0 \to 0$ and the leading singularity is a fixed cut in t. Expansions about classical orbits are possible in the first two cases, and lead in lowest order to a harmonic oscillator equation from which corrections to the classical result may be derived. (auth)

8861 (IAE-2224) QUASI-CLASSICAL PHASE OF SCATTERING IN THE EVENT OF THREE POINT REVERSAL. Bortsaikin, S. M.; Mikhailova, Yu. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Calculations were made of the quasi-classical phase of the scattering in the presence of three reversal points. Cases of two complex and one real and of three real reversal points were examined. The expressions obtained for phases were different from the usual quasiclassical formulas correct in the case of one reversal point. (tr-auth)

8862 (JINR-P4-7403) PERSPECTIVES OF USING INVERSE PROBLEM METHODS IN NUCLEAR PHYSICS. Zakhar'ev, B. N.; Niyazgulov, S. A.; Suz'ko, A. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

After formulating the inverse problem of scattering within the strong-channel-coupling approximation, the possibility of its use was discussed for the following cases: for the complex, and nonlocal interaction; in the three- (and more) body problem when regenerating the many-particle forces from the scattering data; and when extending the mentioned formalism to the relativistic region. (auth)

8863 (RLO-2041-96) DETERMINATION OF REACTION AMPLITUDES FROM EXPERIMENTAL OBSERVABLES. Goldstein, G. R.; Moravcsik, M. J.; Bregman, D. (Tufts Univ., Medford, Mass. (USA). Dept. of Physics; Oregon Univ., Eugene (USA)). 1973. 10p. Dep. NTIS $3.00.

For particle reactions with arbitrary spins a general prescription is outlined and illustrated for the selection of sets of experiments which can completely determine the reaction amplitudes. The prescription involves the inspection of simple numerical matrices, combined with an expedient diagrammatical scheme. (auth)

8864 EXTINCTION THEOREMS IN ELECTROMAGNETIC AND QUANTUM MECHANICAL SCATTERING THEORY. Pattanayak, D. N. Rochester, NY; Univ of Rochester (1973). 124p. University Microfilms Order No. 73-25,841.

Thesis (Ph. D.).

The role of a sharp boundary of a homogeneous, linear and isotropic scattering medium on an incident electromagnetic field is, according to molecular optics, understood from a classic theorem associated with the names of Ewald and Oseen. Recent research has shown that the traditional interpretation of this theorem is incorrect. A generalization of the Ewald-Oseen extinction theorem to scattering from a medium of arbitrary response (e.g., to a nonlinear or to a spatially dispersive medium) is provided and a correct interpretation of it is given. Such a generalization is obtained on the basis of Maxwell's electromagnetic theory. The theorem is shown to play the role of nonlocal boundary conditions on the electromagnetic field vectors. This generalized theorem is used to develop a new method for the solution of scattering problems, which are shown to be equivalent to solutions based on certain integro-differential equations obeyed by the electromagnetic field. The integro-differential equations are different from those customarily found in the literature. The origin of this difference is analyzed and found to arise from a surface term, which is customarily neglected without justification and is due to the discontinuities that the electromagnetic field vectors must necessarily possess at a surface at which the physical properties of the medium are themselves discontinuous. The new formulation is also shown to provide a novel way for studying surface waves. It is shown further that the theory has a close bearing on some problems relating to electromagnetic waves in spatially dispersive media. In particular the theory leads to the resolution of a controversy about the exact form of the boundary conditions that the field vectors must obey on the boundary of such a medium. An analogous theory for nonrelativistic quantum mechanical potential scattering is developed, and the role of the corresponding extinction theorem for the treatment of bound states is discussed. As an illustration of this new approach, the case of a spherically symmetric potential is studied in detail. (Diss. Abstr. Int., B)

8865 CONSTRUCTION OF REPRODUCING KERNELS FOR ANALYTIC HILBERT SPACES. Cutkosky, R. E. (Carnegie-Mellon Univ., Pittsburgh). J. Math. Phys. (N. Y.); 14: No. 9, 1231-1238(Sep 1973).

The reproducing kernels of suitably chosen Hilbert spaces provide a simple but powerful way to generate approximations to functions on which linear data are given. These data may consist either of exact values (for the problem of interpolation) or of values subject to experimental error. For applications, it is important to be able to construct reproducing kernels which embody the information which is available from general considerations about the physics of the problem. Explicit methods are given here for construction of reproducing kernels for Hilbert spaces of analytic functions, these functions being characterized by various types of behavior on the boundary of their domain of holomorphy. (auth)

8866 LARGE COUPLING EXPANSIONS FOR EIGENENERGIES AND REGGE TRAJECTORIES OF THE YUKAWA POTENTIAL. Mueller-Kirsten, H. J. W. (Univ., Kaiserslauter, Ger.); Vahedi-Faridi, N. J. Math. Phys. (N. Y.); 14: No. 9, 1291-1295 (Sep 1973).

Simple and straightforward procedures are developed for deriving complete large coupling expansions for the wave functions, eigenenergies, and Regge trajectories of the generalized Yukawa potential. The procedures may easily be applied to similar problems. (auth)

8867 SCATTERING MATRIX FOR SOME NON-POLYNOMIAL INTERACTIONS. I. Albeverio, S.; Hoegh-Krohn, R. (Univ. of Oslo). Helv. Phys. Acta; 46: No. 4, 504-534(1973).

The study of quantum field theoretical models is continued in n dimensional space–time with interaction densities which are bounded functions of an ultraviolet cut-off boson field. For the scattering matrix of the space cut-off interaction, constructed in terms of asymptotic fields, analyticity in the coupling constant λ and convergence of the linked cluster expansion for sufficiently small λ are proven. The correlation functions and imaginary time Wightman functions for the infinite volume limit constructed previously are also proved to have a linked cluster expansion, convergent for sufficiently small values of λ. This is then used, together with the results on the space cut-off S-matrix, to establish the existence and analyticity in λ of the infinite volume scattering functions and to prove reduction formulas for the infinite Wightman functions. (auth)

8868 CONNECTION OF RENORMALIZED MESON MASS WITH BARE MASS AND CUT-OFF PARAMETER IN SCALAR ELECTRODYNAMICS. Truten, V. I. (Physical-Technical Inst., Kharkov). Teor. Mat. Fiz.; 17: No. 2, 204-209(Nov 1973). (In Russian).

The connection of renormalized scalar meson mass m with the bare mass m_0, the charge and the cut-off parameter Λ is found in the so-called (three-gamma) or $(\alpha L)^n$-approximation. It is shown that in the scalar electrodynamics with going beyond the limits of standard perturbation theory the divergence of the meson proper mass turns out to be linear instead of quadratic one. Non-zero solution for the meson mass m at bare mass equal to zero is obtained. The consideration is carried out in the Duffin–Kemmer formalism. (auth)

8869 VARIATIONAL PRINCIPLES FOR THREE-PARTICLE SYSTEM. Merkur'ev, S. P. (Leningrad State Univ.). Teor. Mat. Fiz.; 17: No. 2, 221-229(Nov 1973). (In Russian).

Variational principles for calculating the scattering matrix elements of $(2 \to 3)$, $(3 \to 2)$ and $(3 \to 3)$ processes are formulated. The principles obtained are similar to the Kohn variational principle. (auth)

8870 LOWER BOUNDS OF THE ELASTIC FORWARD SCATTERING AMPLITUDE. Vernov, Yu. S. (Inst. of Nuclear Research, Moscow). Teor. Mat. Fiz.; 17: No. 2, 199-203(Nov 1973). (In Russian).

The lower asymptotic bound of the forward scattering amplitude is obtained which does not include the arbitrary constant. The lower bound valid for all physical energies is also obtained. (auth)

8871 DUAL AMPLITUDES AND WILSON'S OPERATOR EXPANSION. Olesen, P. (Univ. of Copenhagen). Nuovo Cim.; 18A: No. 3, 480-494(1 Dec 1973).

The N-point Veneziano amplitude is expressed in terms of time-ordered products of currents which (classically) are local in Minkowski space. These currents are suggested by recent work on the "dual string". It is shown that the currents have a

commutator which can be expressed as an analytic function of derivatives acting on a bilocal operator. The bilocal operator can be expanded in a Wilson operator product expansion. (auth)

8872 TOWARDS SATISFACTORY SCATTERING AMPLITUDES FOR DUAL FERMIONS. Olive, D.; Scherk, J. (CERN, Geneva). Nucl. Phys.; B64: No. 2, 334-348(1973).

The modified Lorentz invariant propagator is found which, when used on Neveu-Schwarz meson lines joining fermion lines, guarantees the coupling of just the ghost-free transverse spectrum of meson states. The modification is necessary to take account of the new form of reflected Ward identity valid for such lines. Thus dual amplitudes can be written down for processes involving four external fermions which possess a high degree of inner consistency, no-ghost theorems and Lorentz invariance, but as yet cannot be evaluated. (auth)

8873 COMPARISON OF THREE-DIMENSIONAL RELATIVISTIC SCATTERING EQUATIONS. Woloshyn, R. M.; Jackson, A. D. (State Univ. of New York, Stony Brook). Nucl. Phys.; B64: No. 2, 269-288(1973).

A critical comparison of different three-dimensional approximations to the Bethe–Salpeter equation is made. The threshold value of the second Born term from different equations is calculated and compared with the relativistic results. Extensive numerical results are presented which indicate that for a purely attractive interaction the threshold value of the second Born term is a good indicator of how well a particular equation approximates the Bethe–Salpeter solution. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

8874 HELIUM IN SMALL ASSEMBLIES AND HEAVY NUCLEI. Rasetti, M. (Univ. of Miami, Coral Gables, FL); Regge, T. pp 337-353 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

A lecture is given on the physical properties of small droplets of liquid helium-4, where "small" refers to assemblies of a few hundred atoms. Analogies with heavy nuclei, viz., with the liquid drop model and Strutinsky theory concerning the double humped fission barrier are suggested. (JFP)

8875 EXPERIMENTAL STATUS OF THE AC JOSEPHSON EFFECT IN LIQUID HELIUM. Musinski, D. L. Rochester, NY; Univ. of Rochester (1973). 197p. University Microfilms Order No. 73-25,839.

Thesis (Ph. D.).

The properties of mass flow between two baths of superfluid liquid helium that are coupled by a small orifice were studied experimentally when an ac sound field is present at the site of the orifice. The mass flow between these two baths depends on the intensity and frequency of the sound field, the magnitude of a gravitational head difference applied across the orifice, and a temperature difference between the two baths. Since it was desirable to record the response of the mass flow as a function of these variables separately and in various combinations, an experimental apparatus which allowed the independent variation of these parameters was used. (Diss. Abstr. Int., B)

8876 NUCLEAR MAGNETIC SUSCEPTIBILITY OF DILUTE SOLUTIONS OF ^{3}He IN ^{4}He AT LOW TEMPERATURES. Yaniv, A. (Tel Aviv Univ., Israel). J. Low Temp. Phys.; 13: No. 1-2, 105-111(Oct 1973).

A theory of the nuclear magnetic susceptibility of dilute solutions of ^{3}He in ^{4}He at low temperatures is presented. It is shown that X^{-1} is a linear function of the corresponding inverse free fermion magnetic susceptibility. It is also shown that the experimental Curie constant differs from the theoretical one by an amount which is of the order of the ^{3}He concentration. It follows that the existing experimental results are not adequate for the calculation of the Fermi liquid magnetic susceptibility enhancement factor. (auth)

8877 DOES A PERSISTENT CURRENT EXIST IN A SUPERFLUID HELIUM FILM. Wagner, F. (Univ., Munich). J. Low Temp. Phys.; 13: No. 1/2, 185-193(Oct 1973).

The transfer rate of helium film was measured in a container with typical dimensions of 1 cm. The film flow was induced thermally. Superimposed to the film flow was a rotation of the container. If a velocity difference between substrate and superfluid component were possible, the critical film flow rate would be expected to depend on the angular velocity of the rotation. No such dependence was found. It is concluded that a sizable persistent current in a helium film in this geometry is not possible. This result is in agreement with measurements of Wang and Rudnick and in contradiction to those of Henkel et al. (auth)

8878 DEPOLARIZATION RATIOS AND INTENSITY OF LIGHT RAMAN SCATTERED FROM ROTON PAIRS IN LIQUID ^{4}He. Woerner, R. L.; Greytak, T. J. (Massachusetts Inst. of Tech., Cambridge). J. Low Temp. Phys.; 13: No. 1-2, 149-152 (Oct 1973).

Precise measurements of the depolarization properties and intensity of laser light Raman-scattered from roton pairs in liquid ^{4}He are described and compared with several existing theories. (auth)

8879 THERMODYNAMIC PROPERTIES OF LIQUID ^{3}He–^{4}He MIXTURES NEAR THE TRICRITICAL POINT. I. Vapor Pressure Measurements and Their Thermodynamic Analysis. Goellner, G.; Behringer, R.; Meyer, H. (Duke Univ., Durham, NC). J. Low Temp. Phys.; 13: No 1-2, 113-147(Oct 1973).

Sensitive vapor pressure (P_{sat}) measurements of ^{3}He – ^{4}He mixtures by means of a low-temperature strain gauge are described over the temperature range 0.5–1.5 K and the range $0.4 < X < 0.85$, where X is the ^{3}He mole fraction in the liquid phase. The vapor pressure cell is flat, with a height of only 2mm, in order to reduce concentration gradients near the tricritical point. The pressure-sensitive device, which resolves changes of about 5×10^{-8} atm, is described, and its advantages over a conventional manometer system are discussed. Data taken successively on mixtures of small mole fraction difference are used to locate the phase separation boundary in the T–X plane and also the lambda line from a change in $(\partial P_{sat}/\partial T)_X$ at these transitions. The limiting slopes $(dT/dX)_0$ and $(dT/dX)_\lambda$ of the phase separation curve and lambda line in the vicinity of their junction point, the tricritical point, are presented and compared with previous work. From the vapor pressure data, the concentration susceptibility $(\partial X/\partial\Delta)_{T,P}$ was obtained. Here $\Delta = \mu_3 - \mu_4$ is the chemical potential difference of the respective isotopic components ^{3}He and ^{4}He. It is shown that $(\partial X/\partial\Delta)_T$ diverges as the tricritical point is approached along various paths in the T–X plane, and the relevant tricritical exponents are presented. The weak divergence of $(\partial X/\partial\Delta)_T$ along the lambda line predicted from the postulates of Griffiths and Wheeler could not be detected and it is believed that such divergence has to occur in a temperature interval that is far too small to be resolved with present-day techniques. Furthermore, gravity effects might well prevent observation of the weak divergence. The lambda transition is well evidenced by a distinct "shoulder" in a plot of $(\partial X/\partial\Delta)_T$ at constant X as a function of T. This "shoulder" becomes smaller and gradually gets topped by a peak as X decreases from the tricritical mole fraction X_t. From a combination of vapor pressure and calorimetric data the chemical potential difference $[\Delta(X, T) - \Delta_t]$ is calculated between 0.78 and 1.22 K. Here Δ_t is the value at the tricritical point. From this tabulation the critical line and its slope $(d\Delta/dT)_\lambda$ are obtained and compared with previous values based on calorimetric experiments only and with calculations based on the excess chemical potentials μ_3^E and μ_4^E derived from saturated vapor pressure data. (auth)

Superconductivity

8880 RATIO BETWEEN ENERGY GAP AND TRANSITION TEMPERATURE IN ULTRATHIN SUPERCONDUCTING FILMS. Granqvist, C. G.; Claeson, T. (Chalmers Univ. of Tech., Goteborg). Phys. Lett.; 45A: No. 6, 431-432(5 Nov 1973).

The ratio $2\Delta(0)/k_BT_C$ increases with decreasing film thickness (down to 5 nm) for vapour-quenched micro-crystalline Pb, while it is almost independent of thickness for amorphous Ga and Bi. (auth)

8881 INTERSTITIAL-ELECTRON MODEL FOR THE STRUCTURE OF METALS AND ALLOYS. VI. Interpretation of Superconductivity. Johnson, O. (Hokkaido Univ., Sapporo). Bull. Chem. Soc. Jap.; 46: No. 7, 1935-1940(Jul 1973).

A physical interpretation of the superconducting state based on the interstitial-electron model for metals is given within the framework of the BCS theory. The following conditions for itinerant electrons ($\bar{e}$) and metal ion cores (M^{n+}) are postulated as necessary for superconductivity: (1) There must be a matching of $\bar{e}$ energies (velocity) and binding strength of M^{n+} so $\bar{e}$ initiation of a lattice vibration is possible. (2) Movement of e and M^{n+} must be synchronized so there is enhancement of $\bar{e}$-phonon coupling. (3) There must be $\bar{e}$ of one spin available to enter such $\bar{e}$-phonon "chains". The model leads to $\bar{e}$ of opposite spin in phonon chains 500–5000 Å apart. It gives physical interpretations of the thermodynamic properties of superconductors and clearly shows that type of lattice influences superconductivity. It shows the basis for the new correlation observed between superconductivity and a positive Hall Coefficient. Since the model can incorporate the presence of anions as well as $\bar{e}$, it provides a related explanation for superconductivity in nonmetals. (auth)

8882 SUPERCONDUCTIVITY OF HEAT-TREATED Nb–65 AT. % Ti ALLOY. Witcomb, M. J.; Dew-Hughes, D. (Univ. of Lancaster, Eng.). J. Mater. Sci.; 8: No. 10, 1383-1400 (Oct 1973).

Brief reviews are given of the effect of heat treatment on the microstructure of cold-worked bcc metals and the superconducting properties of niobium alloys. Particular attention is paid to the influence of interstitial impurities in these processes. The annealing effects in microstructure and superconducting properties of a cold-worked Nb–65 at. % Ti alloy, containing oxygen as a major impurity, have been studied. The precipitation process takes the form β TiNb + O_2 → various Ti oxides → αTi + TiO. Differences in precipitation sequence are described for

vacuum-annealing and annealing in impure argon. Flux-pinning is related to the microstructural observations. At least three pinning mechanisms appear to operate; dislocation pinning and two types of precipitate pinning. These observations are in accord with previously proposed pinning models. (auth)

8883 STRUCTURE AND FLUX PENETRATION IN SUPERCONDUCTING NIOBIUM FILMS SPUTTERED ON METALLIC SUBSTRATES. Hlawiczka, P.; Witcomb, M. J. (Univ. of Glasgow). J. Phys., D (London); 6: No. 15, 1793-1797(8 Oct 1973).

Various methods of substrate in situ cleaning have been investigated with the aim of preventing the formation of pinholes which degrade the superconductive properties of sputtered films. Ion bombardment resulted in limited improvement for short etching times, but grossly detrimental for longer periods. Substrate heating, in the case of copper, produced significant improvement both in the structure and purity of the films. Between substrate and film a relatively thin contamination "layer" has been observed and attempts to identify its composition have been made. (auth)

8884 UPPER CRITICAL FIELDS OF LAYERED SUPERCONDUCTING $NbSe_2$ AT LOW TEMPERATURES. Foner, S.; McNiff, E. J. Jr. (Massachusetts Inst. of Tech., Cambridge). Phys. Lett.; 45A: No. 6, 429-430(5 Nov 1973).

The upper critical field versus temperature $H_{c2}(T)$ is presented for several $NbSe_2$ samples. $H_{c2}(T)$ is above the dirty or the clean limit, and at low T is greater than the paramagnetic limiting field. No simple T-dependence is observed. The anisotropy is 3.23 ± 0.03 for $0 \leq H_0 \leq 150$ kG and for $1.2\ K \leq T \leq 4.2K$. (auth)

8885 PHASE TRANSITIONS, SYMMETRY BREAKING, AND ASYMPTOTIC PROPERTIES OF THE GOLDSTONE-MODE FREQUENCY. Schneider, T.; Meier, P. F. (IBM Research Lab., Zurich). Physica; 67: No. 3, 521-532(1 Aug 1973).

Using the nonrelativistic analog of the Goldstone theorem and the theory of collective motion of dynamical variables developed by Mori the Goldstone-mode frequency is given in terms of the order parameter and the long-wavelength form of static susceptibilities. The damping rate is predicted to tend to zero in the long-wavelength limit as the square of the mode frequency. It is shown that the temperature dependence of the Goldstone-mode frequency is, quite generally, proportional to that of the order parameter itself. The general results are applied to the isotropic Heisenberg ferro- and antiferromagnet and superfluid helium. These results confirm predictions derived from the dynamical scaling hypothesis. (auth)

8886 INFLUENCE OF CHANGES OF THE FERMI SURFACE TOPOLOGY ON THERMODYNAMIC PROPERTIES OF IMPURITY SUPERCONDUCTORS. Palistrant, M. E. (Inst. of Applied Physics, Kishinev, USSR). Teor. Mat. Fiz.; 17: No. 2, 293-301 (Nov 1973). (In Russian).

Dependence of critical temperature, ordering parameter, thermodynamic critical field and discontinuity of the heat capacity at the critical point on pressure is investigated for impurity superconductors in the case when the Van Hove singularities in the density of electron states are present. (auth)

8887 NUMERICAL SOLUTIONS FOR THE NONLINEAR PENETRATION OF MAGNETIC FLUX INTO TYPE II SUPERCONDUCTORS. Darby, M. I.; Morton, N. (Univ. of Salford, Eng.). J. Comput. Phys.; 13: No. 1, 35-44(Sep 1973).

The penetration of magnetic flux into a type II superconductor is determined by two coupled, nonlinear, diffusion equations for the flux and temperature. These equations have been written in standard finite difference forms, and in this work solutions have been obtained for values of the time less than a critical value. The latter has been identified with the onset of a physical instability known as a flux jump. (auth)

8888 TEMPERATURE DEPENDENCE AND MICROWAVE ENHANCEMENT OF THE CRITICAL CURRENT OF SUPERCONDUCTING MICROBRIDGES. Jahn, M. T.; Kao, Y. H. (State Univ. of New York, Stony Brook). J. Low Temp. Phys.; 13: No. 1-2, 175-183(Oct 1973).

The temperature dependence of superconducting tin, thin-film, narrow bridges has been investigated. Near T_c the critical current varies with $(1 - T/T_c)^a$, with a distribution of α values between 1 and $^3/_2$. It is suggested that the α values can be used to characterize the bridges. The microwave enhancement of I_c and T_c was measured and these data were compared with a recent theory by Christiansen et al. on the microbridges. It was found that their theory gives a correct prediction for the Dayem effect in the bulklike bridges (with $\alpha = {}^3/_2$) while their theoretical values for the junction-like bridges (with $\alpha = 1$) are not in agreement with our data. (auth)

8889 de HAAS–van ALPHEN EFFECT AND THE FERMI SURFACE OF THE INTERMETALLIC COMPOUND $AuPb_2$. Jan, J. P.; Wenger, A. (National Research Council of Canada, Ottawa). J. Low Temp. Phys.; 13: No. 1/2, 195-208(Oct 1973).

The de Haas–van Alphen effect has been measured in the intermetallic compound $AuPb_2$ (body-centered tetragonal structure) by the modulation method in fields up to 100 kG. Thirty-two frequency branches have been observed in the (100), (110), and (001) planes, and several cyclotron effective masses have been determined. The nearly-free-electron model has been used to construct a Fermi surface, which explains the large frequency branches and is compatible with the high-field magnetoresistance results of Bass, Edwards, and Schroeder. It has been possible to determine the shape of some sheets by inversion of the de Haas–van Alphen data. The lattice parameters have been determined at room temperature and at liquid helium temperature. (auth)

8890 DIAMAGNETIC TRANSITION IN A ZERO-DIMENSIONAL SUPERCONDUCTOR. Buhrman, R. A. Ithaca, NY; Cornell Univ. (1973). 202p. University Microfilms Order No. 73-28,276.

Thesis (Ph. D.).

A metallic superconducting particle all of whose dimensions are less than the superconducting coherence length can be considered to be zero-dimensional from a superconducting point of view in that spatial variations of the superconducting order parameter are energetically very unlikely within the particle. Ensembles of electrically isolated, near perfect single crystal aluminum particles satisfying this criterion have been produced with the average radius ranging from over 1000Å to less than 150Å. With the use of the extremely sensitive superconducting quantum magnetometer the diamagnetic transition of these samples has been carefully examined over a wide range of temperature and applied magnetic field. (Diss. Abstr. Int., B)

8891 THIN, QUENCH-CONDENSED LEAD-BASED ALLOY FILMS INVESTIGATED BY RESISTIVITY AND SUPERCONDUCTING TUNNELING MEASUREMENTS. Granqvist, C. G.; Claeson, T. (Univ. of Tech., Goteborg). J. Low Temp. Phys.; 13: No. 1-2, 1-38(Oct 1973).

Quench-condensed lead-based alloy films were investigated by the superconductive tunneling method to study how structural order affects the phonon distribution, and in particular the appearance of localized impurity modes. As solute, 10 at. % of either Na, Mg, Zn, Ga, Ge, Ag, Cd, In, Sn, Sb, or Te was used. The films were condensed upon a substrate at 0.4 K and studied as deposited and after anneals to 30, 100, and 300 K. It was found that the shape of the phonon-induced tunneling structure could be used as a means to classify the state of structural order in the films. Temperatures of transformations from one state to another could be identified with those where steps occurred in curves of film resistance vs. annealing temperature. The most notable transformation was the one that took the film from an amorphous to a finely grained crystalline state. The transformation temperature scales with the melting point of the pure impurity element of the binary alloy. As the annealing temperature was increased further another temperature region was reached where the crystallites grew in size, causing notable changes in the phonon spectra. A third transformation occurred at low temperatures within the amorphous state for a few of the alloys. Localized impurity modes could be observed only in PbIn and only when the films had been annealed so that relatively large crystallites had formed. The absence of these high-frequency modes in most of the alloy films can be explained as being due to a lack of order or solubility in the ordered state. Such arguments cannot, however, explain why no localized modes are seen in PbSn. In disordered films the phonon distribution is shifted toward lower frequencies compared to the case of a single crystal. For this type of lead-based alloy the shift implies lower values of the superconducting transition temperature T_c and gap $\Delta_0(0)$, but a higher $2\Delta_0(0)/k_BT_c$ ratio. The dependence of these values and of the tunnel resistance upon the structural state is studied. The effect of fluctuations on the superconducting transition is noted for the thin, amorphous films. (auth)

Equipment and Devices

Refer also to abstracts 9631 and 9668.

8892 ELECTRICAL CONDUCTOR FOR SUPERCONDUCTING COILS OR SWITCHES AND METHOD OF FABRICATING SUCH A CONDUCTOR. Kafka, W. German Patent P21,046,004; G71,036,345. 1 Feb 1971. (In German).

Available from the Commission of European Communities, Luxembourg.

This conductor is made up of a large number of superconducting wires which are mutually insulated and twisted, such as a high-frequency cable. The wires consist of flexible glass capillaries which are filled with, for example, lead as the superconducting medium. The mechanical rigidity of the cable is maintained by casting resin and cement leaving, longitudinal interspaces being left between the wires to permit the passages of a cooling liquid. In this configuration the losses due to time-variable electrical currents or magnetic fields are particularly low. (auth)

PHYSICS (NUCLEAR)

8893 IAEA SYMPOSIUM ON APPLICATIONS OF NUCLEAR DATA IN SCIENCE AND TECHNOLOGY. Lewis, W. B. (Atomic Energy of Canada Ltd., Chalk River, Ont.). Energ. Nucl. (Milan); 20: No. 8-9, 449-454(1973).

From IAEA symposium on applications of nuclear data in science and technology; Paris (12 March 1973).

The symposium, held in Paris on March 12 to 16, 1973, was called essentially to consider how the users of nuclear data can best be served by the measurers and compilers of such data. The symposium summary statement is reproduced here. 97 references. (auth)

Neutron Interactions with Matter

Refer also to abstracts 9505 and 9512.

8894 (EURFNR-1111) FORMAT AND MANAGEMENT OF THE GROUP CONSTANT LIBRARY GRUBA. Woll, D. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). May 1973. 38p. (KFK-1815). Dep. NTIS $4.00.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The GRUBA file contains nuclear data of different types, e.g., group-averaged cross sections, transfer elements, and resonance self-shielding factors. The number of energy groups can be chosen arbitrarily. The structure of the data is flexible and allows storage of various kinds of data for the same data type. In order to avoid multiple storing of identical data the pointer technique is applied. The GRUBA file is used to calculate macroscopic group constants by the program GRUCAL. The program system GRUMA allows establishment of a GRUBA file, change in data on a GRUBA file, or extension of an existing GRUBA file. GRUSEEK is a general subroutine which can be called by other programs to read specified nuclear data of the GRUBA file. (auth)

8895 (JINR-P4-7371) MAGNETOVIBRATIONAL SCATTERING OF SLOW NEUTRONS BY ITINERANT FERROMAGNET. Plakida, N. M.; Smirnov, L. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The inelastic part of the magnetic neutron scattering caused by interaction of magnetic electrons with phonons is considered. The longitudinal component of the dynamical spin susceptibility for a one-band itinerant model of a ferromagnet is calculated with account taken of the electron-phonon interaction. (auth)

8896 (ORNL-TM-4408) EFFECTS OF HIGHLY ANISOTROPIC SCATTERING ON MONOENERGETIC NEUTRON TRANSPORT AT DEEP PENETRATIONS. Oblow, E.; Kin, K.; Goldstein, H.; Wagshal, J. J. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 41p. Dep. NTIS $4.25.

The sensitivity of the flux in deep-penetration problems to anisotropic scattering was studied within the framework of monoenergetic transport theory. Several parameterized, anisotropic scattering kernels were used to represent a general class of anisotropies. The representation of these kernels in Legendre polynomial series of various orders was explored to determine their effect on calculated discrete eigenspectra and infinite medium fluxes. Eigenspectra for several kernels are presented as a function of the kernel parameter. Conclusions were drawn about the order of the Legendre expansion of the kernels required for accurate deep-penetration calculations, and the possible existence of multiple diffusion decay modes in realistic problems. In general, rather-low-order Legendre expansion was found to be adequate for problems in which the scalar flux was the primary quantity of interest. (9 figures, 5 tables) (auth)

8897 (RT/FI-(73)19) BENCHMARK EXPERIMENT OF NEUTRON PROPAGATION IN IRON. Martini, M.; Bozzi, L. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 16 May 1973 19p. Dep. NTIS (U. S. Sales Only) $3.00.

Fast-neutron propagation in a large iron block was investigated to check the differential microscopic cross section by integral measurements. The measurements were performed by activation detectors and fission chambers; they consisted in the analysis of the relative reaction rates in the central plane of the block, in the determination of the spectral indexes in the zone of neutron equilibrium spectrum, and in the measurement of such spectrum by the "sandwich" technique. This experiment has been proposed by ESIS as a benchmark case for shielding calculations. (6 figures, 5 tables) (auth)

8898 APPLICATION OF THE METHOD OF MOMENTS FOR THE ANALYSIS OF DATA IN EXPERIMENTS USING A PULSED NEUTRON SOURCE. Pankratenko, D. A.; Topil'skii, L. N. At. Energ. (USSR); 34: No. 6, 475-476(Jun 1973). (In Russian).

By the use of highly intense pulsed neutron sources it is possible to increase significantly the readings taken in the process of carrying out pulsed experiments. The damping decrement of the system can be determined to tenths of a percent. Hence, it is desirable to develop methods which rapidly and accurately give the measured value of the background and damping decrement. The method of moments gives a set of equations which relate the background, ϕ, and the damping decrement, α, with the measured number of counts, N_i, (corrected for dead time) in n channels of an analyzer. It is shown that the equation of the method of moments for the damping decrement, obtained for the drop in neutron density in the absence of a background, coincides with the equation of the method of maximum probability with a Poisson distribution function. The iteration process by means of which the set of equations is solved is set up in such a manner that for calculating the damping increment; use is made of the number of counts corrected for background calculated by the method of moments. At the beginning of the iterative process it is necessary by some simple method to assign a zero approximation of the damping decrement, α_0. The method can be programmed for a small computer. (SJR)

8899 CORRECTION OF THE EFFECTS OF ABSORPTION AND MULTIPLE SCATTERING IN A SCATTERING SAMPLE ON THE ENERGY SPECTRUM OF INELASTICALLY SCATTERED FAST NEUTRONS. Hermsdorf, D.; Seidel, K. (Technische Univ., Dresden). Nucl. Instrum. Methods; 112: No. 3, 469-476 (1973). (In German).

The influence of absorption and multiple scattering of fast neutrons passing through a finite scattering sample on the energy spectrum of inelastically scattered neutrons $\sigma_{n,n'}(E_0; E, \Theta)$ is studied to eliminate this distortion by a correcting factor $f(E_0; E, \Theta)$. In an iterative way f is calculated by means of a Monte-Carlo program whose contents, accuracy, and convergence are discussed. Besides an integral method for determination of f is used. The application of both programs to scattering spectra obtained from the bombardment of cylindrical samples with 14 MeV neutrons results in comparisons. (auth)

8900 MEASUREMENT OF INTEGRATED INTENSITIES IN INELASTIC NEUTRON SCATTERING. Skalyo, J. Jr. (Brooklyn National Lab., Upton, NY); Lurie, N. A. Nucl. Instrum. Methods; 112: No. 3, 571-574(1973).

The use of integrated intensities in neutron inelastic scattering measurements has become an increasingly important source of information for understanding a variety of problems in lattice dynamics. The use of intensity information in studies of both solid helium and neon has permitted investigators to determine the multiphonon character of some spurious peaks observed in constant-Q scans. The single-phonon character of similar unexpected peaks observed in the [100] direction of the alkali metals also could have been determined by intensity considerations. It is reported that spurious peaks (that is, unexpected by symmetry consideration) of single-phonon character are quite naturally observed at small wave vector, q, in all crystalline substances. Furthermore, it is shown that the integrated intensities of all the observed peaks may be properly accounted for by suitable sum-rule considerations. This is demonstrated for [100]L measurements on copper for $|q|$ as small as 0.06 $Å^{-1}$. (2 figures, 1 table) (auth)

8901 THEORY OF NON-STEADY STATE THERMALIZATION OF NEUTRONS. Kazarnovskii, M. V. Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 2-99(1972). (In Russian).

Some problems concerning the thermalization of neutrons from pulsed sources in homogeneous nonbreeding media are considered in this survey: neutron thermalization and transfer equations, the analytical calculation of eigenfunctions and eigenvalues, methods for calculation of the upper limits of a discrete spectrum of eigenvalues for crystalline moderators, and fundamental regularities in neutron thermalization in finite and infinite moderator volumes. (22 figures, 5 tables, 125 references) (tr-auth)

Nuclear Properties and Reactions, A ≤ 5

8902 (ANL-8035, pp 129-131) PERTURBATIVE CALCULATION OF NUCLEON–DEUTERON SCATTERING. Pieper, S. 1973. In Physics Division annual review, 1 April 1972–31 March 1973.

8903 (COO-1265-142) ANNUAL REPORT, 1973. (Minnesota Univ., Minneapolis (USA). John H. Williams Lab. of Nuclear Physics). Sep 1973. Contract AT(11-1)-1265. 209p. Dep. NTIS $12.50.

Research on nuclear structure using H and He beams, including studies of light nuclear systems, spectroscopy of nuclei from F through Ni and with A ≥ 100, isobaric analog states, and optical model studies, is reported. Development of experimental techniques and accelerator operation and development are described. User group activities at LAMPF, personnel, and publications are also included. (RWR)

For title listings of selected papers see: 8904–8907, 8919, 8948–8950, 8968–8972, 8999, 9021, 9022, and 9031–9033.

8904 (COO-1265-142, pp 1-8) STUDY OF D + D SCATTERING AND REACTIONS FROM 11 TO 19 MeV (LAB). Hegland, P. M.; Brown, R. E. Sep 1973.

In Annual Report, 1973.

8905 (COO-1265-142, pp 11-23) RESONATING-GROUP STUDY OF THE d + ^{3}H AND d + ^{3}He SYSTEMS. Chwieroth, F. S.; Brown, R. E.; Tang, Y. C.; Thompson, D. R. Sep 1973.

In annual report, 1973.

8906 (COO-1265-142, pp 24-31) $\alpha + \alpha$ ELASTIC SCATTERING FROM 18 TO 30 MeV (LAB). Chien, W. S.; Brown, R. E. Sep 1973.

In annual report, 1973.

8907 (COO-1265-142, pp 32-44) α-PARTICLE CONTINUUM STUDY AND TOTAL-REACTION-CROSS-SECTION MEASUREMENT FOR ^{3}He + ^{4}He. Koepke, J. A.; Brown, R. E. Sep 1973.

In annual report, 1973.

8908 (COO-1764-180) MICROSCOPIC STUDY OF THE FIVE-NUCLEON SYSTEM. Chwieroth, F. S. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1973. Contract AT(11-1)-1764. 268p. Dep. NTIS $15.50.

Thesis.

The d + ^{3}H and d + ^{3}He systems are examined by the resonating-group method. Interesting features arise because the Pauli exclusion principle has different effects in the S = ½ and ³/₂ channel states. The resonance behavior of the phase shifts is examined; analysis of the various resonances lends insight into the level structures of ^{5}He and ^{5}Li. Deuteron plus three-nucleon scattering is first studied in the one-channel approximation. In order to take account of the loss of flux into other channels, a phenomenological imaginary potential is introduced. Then the N + α channel is included. The phase shifts and cross section in the d + ^{3}H and d + ^{3}He elastic channels are reexamined to see the effect of including the second channel. Elastic scattering in the N + α channel can also be examined with and without the coupling of a second channel. Again, it is necessary to include an imaginary potential to take account of the channels omitted. The one- and two-channel predictions are compared, and the differential cross sections for the reactions d + ^{3}H ⇌ n + α and d + ^{3}He ⇌ p + α are examined. (26 figures, 6 tables) (RWR)

8909 (JINR-P1-7352) ENERGY DEPENDENCE OF THE CROSS SECTION OF FAST DEUTERON KNOCK-OUT FROM Li, Be, AND C BY 380 TO 665 MeV PROTONS. Komarov, V. I.; Kosarev, G. E.; Reshetnikov, G. P.; Savchenko, O. V.; Tesh, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The high energy parts of the spectra of fast deuterons, which are knocked out from Li, Be and C targets by protons at a 5.5° lab. angle with proton energies of 666, 578, 484 and 382 MeV were measured. The cross sections of quasi-elastic deuteron knock-out obtained are compared with the corresponding cross sections of elastic pd-scattering at energies mentioned above. The evaluations of the effective number of two-nucleon clusters are discussed, which have been obtained taking into account (in the Glauber approximation) the incident proton and knocked-out deuteron interactions with nuclear nucleons. The results show the common behavior of the scattering mechanism responsible for elastic pd- and quasi-elastic proton backward scattering with large momentum transfer to two-nucleon clusters. The energy dependence of the deuteron production cross section at the energy kinematically corresponding to the p + N → d + π process on target nucleons is close to that of the cross section for the p + p → d + π^+ process. (auth)

8910 (LA-5393-T) ANALYZING POWER, POLARIZATION, AND POLARIZATION TRANSFER MEASUREMENTS IN THE REACTION T(p,n)^{3}He. Jarmer, J. J. (Los Alamos Scientific Lab., N.Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 142p. Dep. NTIS $5.45.

Thesis. Submitted to Wyoming Univ., Laramie.

Analyzing power was measured with the incident proton beam polarized. Angular distributions were measured for proton energies of 6.00, 9.96, and 13.55 MeV. The analyzing power was also measured at 45° for a proton energy range from 1.51 to 11.95 MeV. Neutron polarization was measured with incident proton beam unpolarized. Angular distributions were measured for proton energies of 5.97 and 9.87 MeV. Polarization transfer was measured; it consisted of measuring the neutron polarization with the incident proton beam polarized. Angular distributions of the transfer observables $K_x^{x'}$, $K_z^{z'}$, and $K_y^{y'}$ were measured for proton energies of 5.97 and 9.94 MeV. The transfer observable $K_z^{z'}$ was measured at 0° for proton energies from 4.0 to 15.0 MeV, and an angular distribution was measured at 10.0 MeV. The $K_z^{z'}$ measurements were made possible by the use of a dipole spin precession magnet, and represent the first measurements of this observable at Van de Graaff energies and the first measurement of $K_z^{z'}$ in a nuclear reaction at any energy. A comparison of the experimental values of the analyzing power and polarization indicates that at the energies of 6.00, 9.96, and 13.55 MeV the data are consistent with equality of these observables. The polarization transfer observables $K_y^{y'}$ and $K_z^{z'}$ were measured to be about 80% of their maximum value. This indicates a large transfer of polarization from the incident proton to the outgoing neutron. All of the data are compared with R-matrix calculations based on the current level structure of ^{4}He. The calculations reproduce qualitative aspects of the data, but quantitative agreement is lacking. In some cases the calculations deviate considerably from the experimental data. The comparison indicates that changes in the current level structure of ^{4}He will be necessary to accommodate the data. (32 figures, 16 tables) (auth)

8911 EFFECT OF PRESSURE ON THE RADIOACTIVE DECAY RATE OF ^{7}Be. Hensley, W. K. Rochester, NY; Univ. of Rochester (1973). 215p. University Microfilms Order No. 73-25,814.

Thesis (Ph. D.).

The effect of pressure on the radioactive decay constant of ^{7}Be was measured by placing samples of ^{7}BeO under static high pressures and measuring the electron capture decay constants (λ) in situ. For this purpose special diamond anvil presses, designed to permit the detection of emitted rays over a large solid angle, were employed. The ^{7}BeO samples were polycrystalline and were surrounded with NaCl or Ag. The NaCl and Ag served as pressure transmitting media as well as internal pressure standards. The lattice parameter of the pressure transmitting medium was determined by standard x-ray diffraction techniques and the pressure calculated from the published equations of state of NaCl and Ag. The decay constants were determined from a least-squares fit of measured activities to the first order radioactive decay law, $A(t) = A(0)\exp(-\lambda t)$. The activities were measured by counting the 477 keV gamma-rays from the daughter ^{7}Li as a function of time. The samples were counted for a period of three half lives, about six months. The measurements were made with high resolution Ge(Li) detectors and standard pulse height analyzers. Samples of uncompressed ^{7}BeO were counted in addition to the compressed samples; and the differential increase in the decay constant of the compressed sample, $(\lambda_C - \lambda)/\lambda$, (where λ_C is the decay constant of the compressed sample) was measured at 0.001, 120, 210, 265, and 270 kbars. A least-squares fit of the equation, $(\lambda_C - \lambda)/\lambda = K_p P$, to the experimental data yields of value of $(22 \pm 1) \times 10^{-6}$ kbar^{-1} for K_p. Theoretical predictions of the effect of compression on the decay constant of ^{7}Be in ^{7}BeO were made with several quantum mechanical models. In each of the models investigated, the effect was estimated by calculating the increase in the electron density at the Be nucleus, $\Delta|\Psi(0)|^2$, when the model volume was reduced by 10%. The quantity $\Delta|\Psi(0)|^2$ was calculated using Hartree-Fock atomic and molecular wave functions. Slater type orbitals were used as basis functions to calculate $\Delta|\Psi(0)|^2$ for the isolated Be atom model (a 0.39% increase) and the BeO molecule (a 0.075% increase). Gaussian type orbitals were used to calculate $\Delta|\Psi(0)|^2$ for the BeO molecule (a 0.11% increase) and the linear BeO_2 molecule (a 0.076% increase). These results are compared with the experimental result of 0.5% at 200 kbars (a volume reduction of ~9%). (Diss. Abstr. Int., B)

8912 CONTRIBUTION FROM MESON CURRENTS TO THE MAGNETIC FORM FACTOR OF ^{3}He AND ^{3}H. Hadjimichael, E.; Barroso, A. (Univ. of Sussex, Eng.). Phys. Lett.; 47B: No. 2, 103-106(29 Oct 1973).

The correction to the magnetic form factor of ^{3}He and ^{3}H arising from mesonic-exchange currents is calculated. The contribution to the πN-resonance excitation diagram via S-D matrix elements is found to be considerable. (auth)

8913 ANALYSIS OF p–^{3}He ELASTIC SCATTERING USING ANALYTICITY. Kisslinger, L. S. (Carnegie-Mellon Univ., Pittsburgh). Phys. Lett.; 47B: No. 2, 93-95(29 Oct 1973).

The techniques of an optimum expansion, obtained by a conformal mapping, are used to obtain the spectroscopic factor for $^3He \rightarrow p + d$. The results are in remarkable agreement with the value obtained from the theory of the three-body problem, and indicates great promise of this technique for nuclear physics. (auth)

8914 INTERACTION OF DEUTERONS WITH TRITIUM AND HELIUM-3 AT LOW ENERGIES. Balashko, Yu. G. Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 130-137(1972). (In Russian).

An analysis of the reactions T(d,n)^{4}He and ^{3}He(d,p)^{4}He was conducted with polarized and nonpolarized deuterons at energies to 2 MeV with the assumption of a contribution of states $\frac{3}{2}^+$, $\frac{1}{2}^+$, and $\frac{3}{2}^-$. (tr-auth)

8915 APPROXIMATION OF THE S MATRIX BY MEANS OF RATIONAL FUNCTIONS. Malyarov, V. V.; Popushoi, M. N. (Odessa Engineering-Construction Inst.). Yadern. Fiz.; 18: No. 5, 1140-1144(Nov 1973). (In Russian).

A method to approximate the S matrix by means of rational functions is considered that enables one to determine the positions and widths of levels in presence of several noncoinciding resonances. Character of position of the scattering matrix poles depending on the "nuclear" phase shift $\delta_l(k)$ is elucidated. As an example, approximation of the matrix $S_l(k)$ at fixed angular momentum l (l = 0, 2, 4, 6) is presented for the case of α-particle scattering on ^{4}He. (auth)

8916 THREE-NUCLEON CALCULATIONS WITHOUT THE EXPLICIT USE OF TWO-BODY POTENTIALS. Sauer, P. U. (Univ., Freiburg i. B.); Tjon, J. A. Nucl. Phys.; A216: No. 3, 541-548(1973).

By using as two-nucleon interaction input the $^3S_1 - {}^3D_1$ and $^1S_0$ partial waves, the Faddeev equations are solved for the three-nucleon bound state. The $^3S_1 - {}^3D_1$ T matrix is calculated from the Reid potential. In order to avoid the usual potential fit, the $^1S_0$ T matrix is directly continued off shell and is constructed consistent with the $^1S_0$ phase shift of elastic two-nucleon scattering. The off-shell part of the $^1S_0$ T matrix is parametrized, and with this parametrization the dependence of the three-nucleon bound-state properties is studied. As a result it is found that the binding energy varies only between 6.2 MeV and 6.8 MeV, while the minimum in the charge form factor for electron scattering from ^{3}He lies between 12.9 fm^{-2} and 18.7 fm^{-2}. The larger (smaller) ^{3}He binding energy is accompanied by a ^{3}He charge form factor whose minimum is at larger (smaller) momentum transfers. (6 figures, 2 tables) (auth)

Nuclear Properties and Reactions, 6 ≤ A ≤ 19

Refer also to abstracts 8715, 8723, 8740, 8774, 8909, 8959, 9008, and 9090.

8917 (ANL-8035, pp 55-56) DETAILED STUDY OF THE $^{12}C(^{12}C,\alpha)^{20}Ne$ REACTION. Greenwood, L. R.; Segel, R. E.; Erskine, J. R.; Fortune, H. T. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8918 (ANL-8035, pp 56-58) PERSISTENCE OF THE $^{12}C + {}^{16}O \rightarrow {}^{28}Si$ RESONANCE IN THE $^{13}C(^{16}O,^{17}O)^{12}C$ REACTION. Debevec, P. T.; Koerner, H. J.; Schiffer, J. P. 1973.

In physics division annual review, 1 April 1972–31 March 1973.

8919 (COO-1265-142, pp 45-53) $^{17}O(^3He,d)^{18}F$ REACTION. King, G. W.; Dehnhard, D.; Brown, R. E. Sep 1973.

In annual report, 1973.

8920 (JINR-P15-7216) STUDY OF REACTION $^{15}N(^3He,p)^{17}O$. Abuzeid, M.; Osetinskii, G. M.; Tyke, Ya.; Fryshchin, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

By using the electrostatic generator of the JINR, the angular distributions and the excitation curves of the $^{15}N(^3He,p)^{17}O$ reaction were measured for p_0, p_1, p_2 channels with the help of a thin gas target in the energy range of 2.2 to 4.2 MeV. The differential cross sections were determined for the p_2 and p_4 channels at the angles of 45°, 90°, 135° in l.s. The results obtained were compared with calculations performed using the DWBA method and the Hauser–Feshbach theory. The problem about the wave function of the second ^{17}O excited state is considered. (auth)

8921 (ORO-1797-47) TABLES FOR PROMPT γ-RAY SPECTROSCOPY I: A = 6 TO A = 20. de Meijer, R. J.; Plendl, H. S. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1973. 46p. Dep. NTIS $4.50.

Observed and possible γ-ray transitions from bound and nearly bound levels of all known nuclides up to A = 20 are tabulated for use in prompt (on-line) γ-ray spectroscopy. The tables include energies, spins, and parities of the nuclear levels, the transition (photo peak) energy corrected for recoil, the corresponding Compton edge and escape peaks, as well as competing decays, mean life, and branching ratios when known. The information is arranged in order of both increasing γ-ray energy and nuclide mass number. (2 tables) (auth)

8922 STUDY OF THE STRUCTURE OF ^{12}B VIA ELASTIC SCATTERING OF NEUTRONS FROM ^{11}B. Nelson, C. E. Athens, OH; Univ. of Ohio (1973). 153p. University Microfilms Order No. 73-25,752.

Thesis (Ph. D.).

A detailed experimental study of the energy levels of ^{12}B through neutron scattering from ^{11}B is of particular interest. The neutron binding energy in ^{12}B is only 3.369 MeV, so that a shell model description of these levels is feasible. Furthermore, states above this energy are not readily excited in order reactions. Clarification of the level structure in ^{12}B is useful for the identification of T = 1 isobaric analog states in ^{12}C, where the existence of prominent T = 0 states makes the analysis of the structure very difficult. Moreover, no systematic differential cross section measurements for ^{11}B have been made above a neutron energy of 2.2 MeV. This analysis of the data leads to the discovery of two previously unobserved resonances in $^{11}B + n$ at E = 2.7 MeV and E = 3.8 MeV, corresponding to states in ^{12}B at E_x = 5.8 MeV and E_x = 6.8 MeV. These states are assigned spin and parity of 1^- and $(1)^+$ respectively. The broad 1^- state is believed to be the 1^- member of the $1p_{\frac{3}{2}}^{-1}1d_{\frac{5}{2}}$ particle-hole multiplet predicted by the shell model calculations. Resonances previously observed in total neutron cross section at E = 2.45 MeV, E = 2.58 MeV and E = 3.5 MeV are assigned spin and parity values of 3^+, 3^- and $(1)^+$. Comparisons are made with the possible T = 1 analog states in ^{12}C corresponding to the states observed in this experiment. Calculations of polarization are made and suggestions for future work in this energy region in ^{12}B are given. The existence of several broad resonances above E = 4.5 MeV in $^{11}B + n$ suggests that a continuation of the study of the structure of ^{12}B at higher neutron energies might lead to the discovery of the members of the last major particle-hole multiplet, $1p_{\frac{3}{2}}^{-1}1d_{\frac{5}{2}}$, calculated by Gillet and Vinh Mau. (Diss. Abstr. Int., B)

8923 STUDY OF THE STRUCTURE OF ^{11}B FROM ELASTIC SCATTERING OF NEUTRONS FROM ^{10}B. Hausladen, S. L. Athens, OH; Univ. of Ohio (1973). 131p. University Microfilms Order No. 73-25,745.

Thesis (Ph. D.).

A study is made of the energy level structure of states in ^{11}B above the neutron threshold at E_x = 11.456 MeV. Elastic scattering differential cross sections for neutrons scattered from ^{10}B are measured for incident neutron energies of 1.5 MeV < E_n < 4.4 MeV. A two-level, four-channel R-matrix analysis of this data and other data leading to states in the compound nucleus ^{11}B is used to extract resonance parameters which describe the energy level structure of ^{11}B in the region of excitation 11.5 MeV < E_x < 15.5 MeV. Results of the analysis indicate a $\frac{5}{2}^-$ (l_n = 1) state at E_x = 13.12 MeV, a $\frac{5}{2}^+$ or $\frac{7}{2}^+$ (l_n = 2) state at E_x = 13.17 MeV, an $\frac{11}{2}^+$ (l_n = 2) state at 14.0 MeV, and a $\frac{3}{2}^+$, $\frac{5}{2}^+$ or $\frac{7}{2}^+$ (l_n = 2) state at 15.2 MeV. The constraints imposed by fitting all the major known reaction data leading to the compound nucleus ^{11}B give particular strength to the conclusions drawn from this study. (Diss. Abstr. Int., B)

8924 BRANCHING RATIOS OF CROSS SECTIONS IN THE CHARGE SYMMETRIC REACTIONS $^{10}B(d,p)^{11}B$ AND $^{10}B(d,n)^{11}C$. Breuer, G.; Mueller, D. (Univ., Hamburg). Z. Phys.; 264: No. 3, 201-210(1973).

It is shown that the investigation of cross section branching ratios of (d,p) and (d,n) reactions which lead to isobaric analog states in the residual nuclei may provide some information about reaction mechanism in the low energy region. For the (d,p) and (d,n) reactions on ^{10}B the calculation of integrated cross sections by use of DWBA shows that the branching ratio is not so sensitive to the choice of the optical model parameters as angular distribution and absolute cross section. Under the assumption of a statistical compound nucleus model the calculated values of branching ratios deviate from those predicted by DWBA, such that the reaction modes can be distinguished. The experimental result is compared with the calculations. (GE)

8925 IS THERE A DISCREPANCY IN ISODOUBLET COULOMB DISPLACEMENT ENERGIES? Noble, J. V. (Univ. of Virginia, Charlottesville). Phys. Lett.; 47B: No. 2, 99-102 (29 Oct 1973).

In mirror nuclei with one valence nucleon outside a doubly closed-shell core, there has been a long-standing discrepancy between experimental and theoretical values of their mass-splitting. If the matter distribution of the core protons in the neutron-rich storage is slightly larger in radius than that for the core protons in the proton-rich analogue, this discrepancy can be explained. (auth)

8926 $^{19}F + p$ REACTION AT $E_p = 669$ keV RESONANCE. I. Fujishiro, M.; Hiraoka, E.; Furuta, J. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 79-85(1972).

$^{19}F(p,\gamma)^{20}Ne$ and $^{19}F(p,\alpha\gamma)^{16}O$ reactions at the 669 keV resonance were investigated through γ-ray spectroscopy with a 40-cm^3 Ge(Li) detector. Previous spectra found in the literature were well resolved, and precise analysis of the data was performed. The spectroscopic comparison and the Doppler broadening of the 7.12-MeV γ ray resulting from the $^{19}F(p,\alpha\gamma)^{16}O$ reaction are reported. (auth)

8927 $^6Li(\vec{d},n)^7Be^*$ REACTION WITH POLARIZED DEUTERONS. Glor, M.; Rudin, H. (Univ., Basel). Helv. Phys. Acta; 46: No. 4, 441-443(1973). (In German).

At deuteron energies below 3 MeV, the $^6Li(\vec{d},n)$ reaction led to the ground level of ^7Be three times more frequently than to the first excited level. The corresponding Q values were 3.38 MeV and 2.95 MeV, respectively. Through n-γ coincidence, the neutron group leading to the excited level was separated from the groups of higher energy. (4 figures) (HBG)

8928 HALF-LIFE OF ^{14}O AND THE FT VALUE OF THE SUPERALLOWED FERMI DECAY. Clark, G. J. (Atomic Energy Research Establishment, Harwell, Eng.); Freeman, J. M.; Robinson, D. C.; Ryder, J. S.; Burcham, W. E.; Squier, G. T. A. Nucl. Phys., A215: No. 3, 429-445(1973).

A series of experiments was carried out to measure the half-life for ^{14}O decay, using different reactions and a variety of techniques, in two laboratories. Considerable care was taken in the experiments, and in the data analyses, to reduce the possibility of systematic errors. The final result obtained is 70.588 ± 0.028 s, where the error is the statistical standard deviation (external error) of the weighted mean. This leads to an ft value for the $0^+ \rightarrow 0^+$ superallowed ^{14}O Fermi decay of 3050 ± 11 s, excluding electromagnetic radiative corrections; the corresponding "effective" ft value is 3090 ± 11 s, allowing for the first-order outer radiative correction. The error quoted for the ft value is determined very largely by the error in the f-value. This result for the ^{14}O Fermi decay is consistent with the ft values for the ^{26m}Al and ^{34}Cl decays. (auth)

8929 HYPERFINE INTERACTIONS OF THE 6.13 MeV, 3^- STATE OF ^{16}O IN IONS OF LOW CHARGE STATE. Broude, C.; Goldberg, M. B.; Goldring, G.; Hass, M.; Renan, M. J.; Sharon, B.; Shkedi, Z.; Start, D. F. H. (Weizmann Inst. of Science, Rehovot, Israel). Nucl. Phys., A215: No. 3, 617-628(1973).

The hyperfine interactions of the 6.13 MeV, 3^- state of ^{16}O in ions recoiling into vacuum with velocity $v/c = 1.06\%$ were studied using perturbed angular correlations. Time-differential and external magnetic field de-coupling experiments were carried out. The de-coupling curve and the time dependence of the perturbation were interpreted in terms of a microscopic calculation yielding values of $|g| = 0.57 \pm 0.05$ and 0.54 ± 0.05 respectively, for the g-factor of the 3^- state. A value of 26.6 ± 0.7 ps for the lifetime of this level was also obtained as a by-product of the investigation. (auth)

8930 GROUND STATE OF ^{12}C IN QUASIPARTICLE METHOD WITH COULOMB FORCES. Sawicki, M. (Univ., Warsaw). Nucl. Phys., A215: No. 3, 477-485(1973).

The nucleus ^{12}C is treated as a system composed of three α-particles. A separable T-matrix is used for the s-wave interaction between two α-particles in the presence of Coulomb forces. The internal structure of the α-particle is taken into account. Applying the Bencze equation a ground state of ^{12}C is found at −7.30 MeV. The calculated radius of the nucleus is significantly smaller than experimentally known. (auth)

8931 TREIMAN-YANG TEST FOR THE POLE APPROXIMATION IN $^6Li(p,pd)^4He$ AT 19 MeV. Liebert, R. B.; Purser, K. H.; Burman, R. L. (Univ. of Rochester, NY). Nucl. Phys., A216: No. 2, 335-348(1973).

The $^6Li(p,pd)^4He$ reaction was tested for dominance of a pole diagram by measurement of the Treiman-Yang distribution at an incident energy of 19 MeV. The resulting T-Y distributions were consistent with the isotropic pole predictions in the 0-60 MeV/c region of deuteron cluster momentum in ^6Li. Absolute cross sections were obtained in the region of the test and were fitted with a plane wave impulse approximation and surface cut-off as prescribed by Shapiro. The reduced width for a deuteron in ^6Li obtained for a cutoff radius of 5.7 fm was $\theta_d^2 = 0.23 \pm 0.09$ corresponding to an effective deuteron cluster number $N_{eff} = 0.13 \pm 0.05$. (auth)

8932 EXPERIMENTAL VERIFICATION OF A METHOD FOR CALCULATING THE CROSS SECTIONS OF PHOTONUCLEAR REACTIONS ON THE BASIS OF MATHEMATICAL STATISTICS. Ivanchenko, V. G.; Ratner, B. S. Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 142-145(1972). (In Russian).

A detailed study of the reaction $^{16}O(\gamma,n)^{15}O$ aided in verifying a method for calculating cross sections of photonuclear reactions from the yield curves. Measurements of the yield of this reaction in steps of 0.1 MeV were conducted from its threshold to $E_\gamma = 22.15$ MeV with the FIAN cyclotron, and good agreement with calculated values was obtained. Features of the new method of computation are compared with other methods of calculating cross sections. (tr-auth)

8933 MEASUREMENTS OF $^{12}C(\pi^+,\pi N)^{11}C$ AND $^{19}F(\pi^+,\pi N)^{18}F$ CROSS SECTIONS NEAR THE 3/2, 3/2 RESONANCE. Hogstrom, K. R. (Univ. of Houston, TX); Mayes, B. W.; Lee, L. Y.; Allred, J. C.; Goodman, C.; Mutchler, G. S.; Fletcher, C. R.; Phillips, G. C. Nucl. Phys., A215: No. 3, 598-604(1973).

Reaction cross sections for $^{12}C(\pi^+,\pi N)^{11}C$ at 134, 161, 177, and 200 MeV and for $^{19}F(\pi^+,\pi N)$ at 161, 177, and 200 MeV were measured by activation methods. (auth)

8934 POLARIZATION IN THE INELASTIC SCATTERING OF 185 MeV PROTONS. Ingemarsson, A. (Uppsala Univ.); Hagberg, E.; Sherif, H. Nucl. Phys., A216: No. 2, 271-284 (1973).

The polarizations produced in the inelastic scattering of 185 MeV protons exciting the lowest octupole states in ^{12}C and ^{208}Pb are measured. The data together with earlier similar measurements for ^{40}Ca and ^{90}Zr are compared with existing theoretical models. The inclusion of a deformed spin-dependent interaction of the full Thomas form in the DWBA amplitude is found to considerably improve the theoretical fits to the data. For ^{12}C, however, the DWBA fit is found to be inferior to that obtained using DWIA. The strong absorption model is found to give qualitatively good fits to the data for the heavier nuclei but again fails in the ^{12}C case. (auth)

8935 ALPHA-GAMMA REACTION TEST OF PARITY NON-CONSERVATION IN NUCLEAR PHYSICS. Gari, M. (State Univ. of New York, Stony Brook); Huffman, A. H. Nucl. Phys., A215: No. 3, 532-540(1973).

A parity-forbidden $^{12}C(\alpha,\gamma)^{16}O$ reaction through the 11.08 MeV 3^+ state is proposed to obtain new information on irregular α-widths. New calculations of the irregular α-width of the 11.08 MeV 3^+ state are presented which include both the two pion and rho exchange contributions. The irregular α-width of the 4.97 MeV 2^- state of ^{20}Ne is estimated, and it is confirmed that this state makes a negligible contribution to the astrophysical helium-burning reaction, $^{16}O(\alpha,\gamma)^{20}Ne$. (auth)

8936 EMISSION OF CHARGED PARTICLES IN CAPTURE OF μ^--MESONS BY PHOTOEMULSION NUCLEI. Batusov, Yu. A.; Bunyatov, S. A.; Vizireva, L.; Gulkanyan, G. R.; Mirsalikhova, F.; Sidorov, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 5, 962-967(Nov 1973). (In Russian).

Emission probabilities and multiplicity distributions for charged particles at capture of μ^--mesons by light (C, N, O) and heavy (Ag, Br) photoemulsion nuclei are obtained. At the muon capture by the light nuclei the following probabilities (per a capture event) of the charged particle emission are found: for two charged particles $w_2 = (4.4 \pm 0.7)\%$, for three particles $w_3 = (2.1 \pm 0.2)\%$, for four particles $w_4 = (0.7 \pm 0.1)\%$. For every nucleus C, N, O upper bounds are presented for the channel probabilities of reactions with emission of two, three and four charged particles. (auth)

8937 ANGULAR DISTRIBUTIONS OF SECONDARY γ-QUANTA AND THE TOTAL CROSS SECTIONS FOR EXCITATION OF NUCLEI BY HIGH ENERGY PARTICLES. Mileev, V. N.; Mishchenko, T. V. (Moscow State Univ.). Phys. Lett.; 47B: No. 3, 197-199 (12 Nov 1973).

The angular distributions of secondary γ-quanta were investigated, and the cross sections for excitation of the lowest collective levels $(2^+,0)$ in ^{12}C, $(3^-,0)$ in ^{16}O and (3^-) in ^{208}Pb in inelastic scattering of 1 GeV protons were calculated. (auth)

8938 EXCITATION OF LEVEL COMPLEXES IN ^{28}Si BY MEANS OF ELECTRON INELASTIC SCATTERING. Chkalov, I. I.; Shevchenko, N. G.; Afanas'ev, N. G.; Zalyubovskii, I. I.; Khomich, A. A.; Polishchuk, V. N.; Litvinenko, A. S.; Buki, A. Yu. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 18: No. 5, 945-949 (Nov 1973). (In Russian).

Five spectra of electrons scattered by ^{28}Si are measured at $\theta = 135°$ and $E_0 = 107.7$, 134.9, 162.8, 191, and 219.9 MeV. At the excitation energies of 11.2, 12.2, and 13.65 MeV peaks are observed in the experiment, that are predicted by the particle-hole model of the nucleus as a state with quantum numbers 3^+ (2^+ and 4^+) and (4^- and 6^-), respectively. Form factors of the giant resonance and those of the 11-MeV and 14-MeV level complexes are in good agreement with the corresponding theoretical form factors, calculated on basis of the particle-hole model. The strongly excited state 5^- at 20.34 MeV, predicted by the theory, was not observed in the experimental spectra. (auth)

8939 BACKWARD SCATTERING OF α PARTICLES ON ^{12}C AND ^{13}C. Kuznetsov, B. I.; Chernov, I. P.; Ovsyannikova, R. E. (Tomsk Polytechnic Inst., USSR). Yadern. Fiz.; 18: No. 5, 950-953(Nov 1973). (In Russian).

Angular distributions of α particles scattered from ^{12}C and ^{13}C nuclei are measured in the 110°–178° c.m. angular range at energies 18, 19, 22, 24, 25 and 26.6 MeV. A sharp decrease of the cross section at all the energies is observed in scattering of the α particles on the ^{12}C nucleus at angles close to 180°. The angular distributions for ^{13}C in the 18–22-MeV energy range have a shape similar to the shape of the angular distributions for ^{13}C. At 24 MeV the extrema are in opposite phases and at 25 MeV the backward scattering cross section for ^{13}C decreases. The observed increase of the backward scattering cross section is explained due to the contribution from a heavy-particle stripping and from decay of intermediate α-cluster states given to the elastic part of the exchange interaction. (auth)

8940 PION–NUCLEAR TOTAL CROSS SECTIONS NEAR THE $3/2$, $3/2$ RESONANCE. Gabitzsch, N. D. (Rice Univ., Houston, TX); Mutchler, G. S.; Fletcher, C. R.; Hungerford, E. V.; Coulson, L.; Mann, D.; Witten, T.; Furic, M.; Phillips, G. C.; Mayes, B.; Lee, L. Y.; Hudomalj, J.; Allred, J. C.; Goodman, A. C. Phys. Lett.; 47B: No. 3, 234-236(12 Nov 1973).

The π^+ total nuclear cross sections for ^{9}Be, ^{12}C, ^{16}O, and ^{27}Al were measured in the energy range 114 to 210 MeV, while π^- data were taken at 153 MeV. In the center-of-mass coordinate system the π-nucleus total cross sections reach their maximum value near the π-nucleon ($3/2$, $3/2$) resonance ($T_\pi^{c.m.} = 152$ MeV) where they scale as $A^{\frac{2}{3}}$. The measured total cross sections exhibit considerable broadening with respect to the π-nucleon resonance. (auth)

8941 ANALYSIS OF (p,d) REACTIONS IN THE PERIPHERAL MODEL WITH NUCLEAR FORM FACTOR. Orlov, Yu. V. (Moscow State Univ.). Yadern. Fiz.; 18: No. 5, 1028-1033(Nov 1973). (In Russian).

In order to find out the effects of taking into account the momentum transfer dependence of the nuclear vertex part B ⇔ A + n of the pole graph for the reaction B(p, d)A in peripheral model the cross section is calculated with and without form factor. The calculations are compared with the data for the reactions ^{16}O(p, d) ^{17}O (0.87 MeV, $1/2^+$) and ^{19}F(p, d)^{18}F (over a broad energy region in the last case). It is found that the extracted coupling constant G^2 (the square of the vertex part on the mass shell) can increase by a factor ≤ 2 at the proton energies ≤ 60 MeV. The form factor was calculated in the one-particle model. (auth)

8942 CALCULATION OF CROSS SECTION FOR PION PHOTOPRODUCTION ON NUCLEI. Shebeko, A. V.; Goncharov, N. V. (Physical-Technical Inst., Kharkov). Yadern. Fiz.; 18: No. 5, 1034-1045(Nov 1973). (In Russian).

The method is proposed to calculate angular and energy distributions of π-mesons produced in photoproduction reactions on nuclei. The interaction of γ-quanta with nuclei is treated in impulse approximation and the interaction of produced π-mesons with a nucleus is calculated using the optical model. The Fermi-gas and the oscillatory-shell models are used. The obtained energy spectra of positive pions produced on carbon are compared with the data. (auth)

8943 COMPLEX HAMILTONIAN AND THREE α RESONANCES. Avishai, Y. (University of the Negev, Beer Sheva, Israel). Phys. Lett.; 47B: No. 3, 222-224(12 Nov 1973).

A method of dealing with many particle resonances, first suggested by Lovelace, is here applied to a system of three structureless α particles, interacting via s wave rank one separable potential. The parameters of the interaction were given the values which led Harrington to predict a 12.8 MeV binding energy for the ^{12}C ground state. A 1^- resonance was found at $E_0 - i\Gamma/2 = 2.071 - 0.05i$, which is comparable with the experimental one at $E_0 - i\Gamma/2 = 2.225 - 0.05i$. The wave function of the resonance is defined and computed in configuration space. (auth)

8944 DOPPLER EFFECT IN INELASTIC SCATTERING OF FAST NEUTRONS IN BULKY MASSES OF SUBSTANCES. Guma, V. I. (All-Union Scientific-Research Inst. of Nuclear Geophysics and Geochemistry, Moscow). pp 31-36 of Voprosy Yadernoi Geofiziki i Neftegazopoiskovoi Geokhimii. Moscow; Vsesoyuznyi Nauchno-Issledovatel'skii Institut Yadernoi Geofiziki i Geokhimii (1972). (In Russian).

The physical processes leading to Doppler broadening of the 4.43-MeV lines in the γ spectrum and arising during inelastic scattering of 14-MeV neutrons by carbon nuclei were examined. The shape of the broadened line was calculated analytically with only neutrons of the primary collision considered. Its dependence on the geometrical parameters was investigated. The calculations were done by computer. (tr-auth)

8945 MEDIUM ENERGY CLUSTER KNOCK-OUT REACTIONS ON ^{6}Li AND THEIR INTERPRETATION IN TERMS OF DISTORTED WAVES. Jain, A. K.; Grossiord, J. Y.; Chevallier, M.; Gaillard, P.; Guichard, A.; Gusakow, M.; Pizzi, J. R. (Institut de Physique Nucleaire de Lyon, Villeurbanne, France). Nucl. Phys.; A216: No. 3, 519-540(1973).

The ^{6}Li(d,2d)^{4}He and ^{6}Li(d,dα)^{2}H reactions were performed at 27 MeV. Analyses of these and the 42.8- and 55-MeV ^{6}Li(α,2α)^{2}H reactions were performed using distorted-wave and plane-wave impulse approximations. The kinematic and potential coupling approximations to the final-state three-body Schroedinger equation and the post and prior form approximations to off-shell scattering cross section were studied for the three reactions. It was found that only the kinematic coupling and post form approximations could be used for consistent analyses of the three reactions. The effects of distortions and localization of the reactions were investigated. Manifestations of deuteron cluster deformation were noticed in the analyses of the three reactions. (auth)

8946 DISTRIBUTION OF ELECTRIC MULTIPOLE STRENGTH STRENGTH IN ^{19}F FROM INELASTIC SCATTERING OF 25 MeV α-PARTICLES. Krick, T. P.; Hintz, N. M.; Dehnhard, D. (Univ. of Minnesota, Minneapolis). Nucl. Phys.; A216: No. 3, 549-562 (1973).

Differential cross sections were measured for elastic and inelastic scattering of 25.0-MeV α particles from ^{19}F for the first 21 excited states. The experimental results were analyzed in terms of DWBA by using the collective form factor description. Significant octupole strength was found for the 5.428-MeV (3.48 W. u.) and 5.630-MeV states (2.36 W. u.), in addition to that for the 1.35-MeV state (1.93 W. u.). The ground-state rotational band was analyzed with the coupled-channel Born approximation to extract quadrupole and hexadecapole deformation parameters ($\beta_2 = 0.35$ and $\beta_4 = 0.12$). The ^{19}F(α,α') results are compared to the results of other experimental and theoretical investigations. A major discrepancy still exists between nuclear inelastic and electromagnetic measurements of the octupole transition strength to the 1.35-MeV state. (auth)

8947 MIRROR ASYMMETRY IN ALLOWED GAMOW–TELLER β-DECAY. Towner, I. S. (Chalk River Nuclear Labs., Ont.). Nucl. Phys.; A216: No. 3, 589-602(1973).

The difference in ft values for mirror Gamow–Teller β decays was estimated for the p-shell mass multiplets A = 8, 9, 12, and 13. Most important are the binding energy effects, which are calculated with various Saxon–Woods single-particle models. The results are very parameter-dependent; nevertheless, all models predict a larger asymmetry, δ, in even-A than in odd-A multiplets. This is contrary to experimental data. The effects of charge-dependent Coulomb mixing are considered by repeating the Cohen–Kurath shell-model calculations in a proton–neutron formalism. In most cases the effects were small, but in some odd-A decays a significant contribution to δ was obtained, which partially resolves the discrepancy just noted. The influence on δ of second-forbidden matrix elements and radiative corrections is small. (1 figure, 3 tables) (auth)

Nuclear Properties and Reactions, $20 \leq A \leq 38$

Refer also to abstracts 7874, 8740, 8917, 8921, and 8940.

8948 (COO-1265-142, pp 55-64) PROTON STRIPPING INTO THE SILICON ISOTOPES VIA THE (^{3}He,d) REACTION. Dykoski, W. W.; Dehnhard, D. Sep 1973.

In annual report, 1973.

8949 (COO-1265-142, pp 65-71) COUPLED-CHANNEL-BORN-APPROXIMATION ANALYSIS OF ^{22}Ne(p,t)^{20}Ne TRANSITIONS. Olsen, D. K.; Udagawa, T.; Tamura, T.; Brown, R. E. Sep 1973.

In annual report, 1973.

8950 (COO-1265-142, pp 159-164) ELASTIC SCATTERING OF SULFUR ON SULFUR. Gavin, P.; Hintz, N. M.; Moss, J. Sep 1973.

In annual report, 1973.

8951 (JUL-963-KP) SELF-CONSISTENT TREATMENT OF CORRELATIONS IN LIGHT NUCLEI. Schmid, K. W. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Jun 1973. 177p. (In German). Dep. NTIS (U. S. Sales Only) $11.00.

Thesis. Submitted to Muenster Univ. (West Germany).

This work gives a systematic analysis of intrinsic ground states of several even–even nuclei in the s–d shell. For this purpose, multi-configuration Hartree–Fock (MCHF) calculations are performed for nearly all nuclei with N = Z and N = Z + 2 in the s–d shell, with different configuration spaces and effective interactions. From the resulting intrinsic ground states the ground-state bands of these nuclei have been calculated by means of an angular momentum projection. Furthermore, for ^{20}Ne and ^{22}Ne nuclei, MCHF calculations have been performed in the laboratory system, i.e. with an angular momentum projection prior to the variation of the internal degrees of freedom. (6 figures, 17 tables) (GE)

8952 (RT/FI-(73)18) LONG-LIVED SODIUM ACTIVITY FROM A FAST REACTOR. Martini, M.; Moioli, P.; Romanelli, C. M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 5 Jun 1973. (In Italian). Dep. NTIS (U. S. Sales Only) $3.75.

The ^{23}Na(n,2n)^{22}Na cross section was measured in two different ways; the first in the TRIGA reactor, with the sodium sample surrounded by a natural boron shield, the second in the central channel of the TAPIRO reactor. Irradiated samples were investigated either to measure the ^{23}Na(n,2n)^{22}Na cross section or to determine the impurities present and their activation cross sections. Unsatisfactory results for the second problem suggested evaluation of the impurity activations by calculation; therefore, a set of group constants for reactions of interest was prepared. (3 figures, 3 tables) (auth)

8953 COULOMB CORRECTIONS TO THE INDUCED PSEUDOSCALAR TERM IN NUCLEAR MUON CAPTURE. Fulcher, L. P.; Mukhopadhyay, N. C. (Univ. of Maryland, College Park). Phys. Lett.; 47B: No. 2, 115-118(29 Oct 1973).

Coulomb corrections to the induced pseudoscalar term, which appears in impulse approximation treatment of nuclear muon capture, are calculated. It is found that it is important to include the effect of finite nuclear size in order to obtain a reliable result. These corrections are found to be too small to account for the difference between the PCAC value for this term and the values necessary to understand recent muon capture experiments in ^{16}O and ^{40}Ca. (auth)

8954 GENERALIZED SHELLS IN NUCLEI: HARTREE–FOCK CALCULATIONS FOR BUBBLE NUCLEI. Davies, K. T. R.; Krieger, S. J.; Wong, C. Y. (Oak Ridge National Lab., TN). Nucl. Phys., A216: No. 2, 250-270(1973).

Hartree-Fock calculations in the bubble degree of freedom have been performed on a variety of spherical nuclei. Of particular importance are incipient bubble configurations in ^{36}Ar, ^{68}Se, ^{84}Se, ^{100}Sn, ^{116}Ce, ^{138}Ce and ^{200}Hg, each of which possesses a binding energy which is comparable to that of the normal spherical closed-shell configuration. The densities of the above nuclei display strong deviations from a uniform shape, and give rise to depletions in the nuclear interior. These nonuniformities are due both to the absence of low angular momentum states in otherwise normally occupied spherical shells, and also to strong self-consistency effects. The nonuniformities in the mass density are further enhanced for nuclei whose neutron and proton densities have depressions or peaks at approximately the same distance from the center of the nucleus. A depression of the central density is most pronounced in the nuclei ^{36}Ar, ^{138}Ce and ^{200}Hg. Interior depletions of the density are associated with the relatively higher energies of low angular momentum single-particle levels as compared to high angular momentum single-particle levels. This effect can give rise to moderately large gaps at the Fermi surface. Finally, it is shown that in a bubble configuration, the spin-orbit splitting of low lying doublets is sometimes reversed, and that this effect is especially pronounced for levels with low angular momentum. (auth)

8955 INVESTIGATION OF THE REACTION ^{28}Si(^{3}He,p)^{30}P. Nikitenko, Yu. V.; Osetinskii, G. M.; Song Wong Nam; Faruk, M. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 5, 954-961(Nov 1973). (In Russian).

Reaction ^{28}Si(^{3}He,p)^{30}P was investigated in the energy interval 2.9–4.25 MeV. The excitation functions for the ground state and for four lower lying states of the final nucleus (p_0, $p_{1,2}$, p_3, p_4) are measured under the angles of 45, 90, 135, 160°. Angular distributions are measured for p_0, $p_{1,2}$ and p_3 states. It is established that the measured differential cross sections are results of superposition of two mechanisms: formation of the compound nucleus and the direct reaction. Experimental data on the angular distributions were compared with calculations fulfilled using the distorted-wave Born approximation and the Hauser–Feshbach statistical approach. The mean value of the level widths for the compound nucleus ^{31}Si in domain of the excitation energies 15.06–16.15 MeV was determined. (auth)

8956 PROBING NUCLEAR SURFACES BY HEAVY ION REACTIONS. Nilsson, B. (NORDITA, Copenhagen); Broglia, R. A.; Landowne, S.; Liotta, R.; Winther, A. Phys. Lett.; 47B: No. 3, 189-192(12 Nov 1973).

An analysis of the recently measured ^{16}O + ^{26}Mg one- and two-proton transfer reactions is given. It is shown that these reactions probe progressively deeper regions of the surface of the two colliding nuclei. (auth)

8957 PSEUDO SU(3) AND THE EXTENSION OF THE GROUND STATE ROTATIONAL BAND. Strottman, D. (Nuclear Physics Lab., Oxford). Phys. Lett.; 47B: No. 3, 215-218(12 Nov 1973).

By adding the 0g orbit to the 1s–0d orbitals, a pseudo sdg shell is created. It is demonstrated that the leading pseudo SU(3) states give a good description of the A = 18 system; calculations in the ^{20}Ne show an enhanced B(E2 : 10 → 8). (auth)

8958 BAND STRUCTURE IN ^{22}Na. Gunye, M. R. (Tata Inst. of Fundamental Research, Bombay). Phys. Lett.; 47B: No. 3, 219-221(12 Nov 1973).

The nuclear properties of the low-lying positive parity states in ^{22}Na are satisfactorily explained in terms of the K = 3 (T = 0), K = 0 (T = 0) and K = 0 (T = 1) bands obtained from a multishell self-consistent calculation. (auth)

8959 ALPHA-DECAY WIDTHS IN ^{20}Ne. Haeusser, O.; Alexander, T. K.; Disdier, D. L.; Ferguson, A. J.; McDonald, A. B.; Towner, I. S. (Chalk River Nuclear Labs., Ont.). Nucl. Phys.; A216: No. 3, 617-628(1973).

The α decay of several unbound levels in ^{20}Ne was studied by ^{16}O(α,α) elastic and inelastic scattering. A narrow resonance, $\Gamma_{c.m.}$ = 13 ± 4 eV, with $J^\pi = 5^-$ was found at $E_x(^{20}Ne)$ = 8.451 ± 0.005 MeV, and is associated with the lowest K = 2$^-$ quasi-rotational band. Several new, narrow resonances were found between E_x = 16.0 and 18.4 MeV. Reduced α-decay widths were obtained for the lowest K = 0$^+$, 2$^-$, and 0$^-$ bands. For states described predominantly by the (8,2) representation of SU(3), a reduction of the reduced widths with increasing spin was noted. Reduced widths of positive-parity bands are reviewed. (auth)

8960 CONSISTENCY STUDY OF DSA LIFETIME MEASUREMENTS. Broude, C.; Beck, F. A.; Engelstein, P. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Phys.; A216: No. 3, 603-618(1973).

The mean life of the 1.01-MeV state in ^{27}Al was measured by the recoil distance method to be 2.37 ± 0.12 ps. Doppler-shift line-shape analysis in five backings gives values 2.27 ± 0.04 (Ca), 2.13 ± 0.07 (Ti), 1.73 ± 0.08 (Cu), 2.15 ± 0.04 (Ba), 1.68 ± 0.06 (Ta), 1.77 ± 0.07 ps (Au), where the quoted errors are statistical only. This dependence of the DSA values on atomic number agrees with previous measurements of this effect. The data support the suggestion that the longer DSA values are correct. A complete method for analysis of recoil distance data is described and checked against measurements of the ^{27}Al 0.84-MeV and ^{24}Mg 1.37-MeV states. (auth)

8961 STRUCTURE CALCULATIONS FOR ^{25}Mg–^{25}Al. Draayer, J. P. (Univ. of Michigan, Ann Arbor). Nucl. Phys.; A216: No. 3, 457-476(1973).

The results of a shell-model calculation for ^{25}Mg–^{25}Al are presented in which the Hamiltonian for the system was taken to be that of an inert ^{16}O core plus nine s–d shell particles interacting through the usual one-body l^2 and $l \cdot s$ terms plus general two-body residual interactions of the Kuo–Brown type. The basis was truncated to include nine favored representations of SU(3) in each of the two leading spatial symmetries ([441]: (66), (93), (74), (82)^2, (55)^2, (28), (90); [432]: (10.1), (74), (82)^2, (55)^2, (28), (47), (90)). It is found that a ($\lambda\mu$)-dependent renormalization of the type proposed by Harvey but empirically modified for axially asymmetric shape distributions is required to reproduce the experimentally observed ordering of the three lowest rotational bands. The goodness of K_J as a band label for the calculated eigenstates is investigated by comparing calculated quadrupole moments with simple rotational-model predictions. Calculated B(E2) and B(M1) rates are compared with the available data. Results for relative spectroscopic factors from (d,p) stripping on the ground state of ^{24}Mg are also presented. (1 figure, 6 tables) (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 7874, 8740, 8925, 9015, and 9089.

8962 (ANL-7989) MEASUREMENT OF ^{58}Ni(n,p)^{58}Co REACTION CROSS SECTIONS FOR E_n = 0.44-5.87 MeV USING ACTIVATION METHODS. Smith, D. L.; Meadows, J. W. (Argonne National Lab., Ill. (USA)). Aug 1973. Contract W-31-109-eng-38. 43p. Dep. NTIS $4.00.

Cross sections for the ^{58}Ni(n,p)^{58}Co reaction relative to the ^{235}U fission cross section were measured for neutrons with energies in the range E_n = 0.44 to 5.87 MeV by observing the ^{58}Co gamma-ray activity of natural-nickel-metal samples irradiated with fast neutrons. The neutron flux was monitored by measuring the fission yields from uranium deposits in a fission chamber that was irradiated along with the nickel samples. The activities of these samples were determined by measuring their de-excitation gamma-ray yields with detectors having known efficiencies. The procedures used in the acquisition and analysis of the experimental data are discussed in detail. (13 figures, 9 tables) (auth)

8963 (ANL-8035, pp 73-75) ^{6}Li AND ^{7}Li ELASTIC AND INELASTIC SCATTERING IN THE CALCIUM REGION. Fink, C. L.; Strohbusch, U.; Zeidman, B. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8964 (ANL-8035, pp 75-77) INTERFERENCE BETWEEN COULOMB AND NUCLEAR POTENTIALS IN ^{7}Li INELASTIC SCATTERING ON ^{56}Fe. Fink, C. L.; Katori, K.; Morrison, G. C.; Zeidman, B. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8965 (ANL-8035, pp 82-84) ^{41}K(^{6}He,t)^{41}Ca AND ^{89}Y(^{6}He,t) ^{89}Zr REACTIONS. Greenwood, M. S.; Greenwood, L. R.; Anantaraman, N.; Pluta, M. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8966 (ANL-8035, pp 91-92) γ DECAY OF HIGH-SPIN STATES IN ^{47}Ti. Sjoreen, T.; Meyer-Schuetzmeister, L.; Hardie, G. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8967 (ANL-8035, pp 124-125) CCBA ANALYSIS OF HEAVY-ION REACTIONS. Low, K. S.; Tamura, T. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8968 (COO-1265-142, pp 74-79) PROTON OCCUPATION NUMBERS FOR ^{44}Ca VIA THE ^{44}Ca(d,^{3}He)^{43}K REACTION. Dehnhard, D.; Cage, M. E. Sep 1973.

In annual report, 1973.

8969 (COO-1265-142, pp 80-82) EXCITATION OF THE 2p AND 1f STATES IN ^{49}Sc BY THE ^{50}Ti(d,^{3}He) REACTION. Taketani, H.; Sharma, H. L. Sep 1973.

In annual report, 1973.

8970 (COO-1265-142, pp 83-88) ELASTIC SCATTERING OF 19-MeV DEUTERONS BY THE FIVE STABLE TITANIUM ISOTOPES. Willits, R. E.; Poppe, C. H.; Wallen, R. A. Sep 1973.

In annual report, 1973.

8971 (COO-1265-142, pp 84; 89-97) STUDY OF THE ^{56}Fe (d,p)^{57}Fe REACTION. Dehnhard, D.; Clark, D. L. Sep 1973.

In annual report, 1973.

8972 (COO-1265-142, pp 98-104) ELASTIC SCATTERING OF ALPHA PARTICLES FROM ^{58}Ni. Snyder, R.; Lilley, J. S.; Greenlees, G. W. Sep 1973.

In annual report, 1973.

8973 (JINR-P6-7236) BETA DECAY OF ^{41}Cl. Gurach, Kh.; Kabachenko, A. P.; Kuznetsov, I. V.; Tarantin, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

^{41}Cl beta-decay is studied using the mass-separator EMSNAPTI on-line with the heavy-ion cyclotron. The ^{41}Cl isotope was produced in the three-nucleon transfer reaction ^{181}Ta(^{40}Ar,^{41}Cl). The maximum energy of the β particles and the total β-decay energy were measured to be 3.80 ± 0.15 and 5.67 ± 0.16 MeV, respectively. The ^{41}Cl half-life is of 34 ± 3 s. The decay mode of this isotope is given. (5 figures) (auth)

8974 NUCLEAR MAGNETIC MOMENT MEASUREMENTS IN ^{54}Fe AND ^{48}Ca. Hensler, R. L. New Brunswick, NJ; Rutgers-The State Univ. (1973). 142p. University Microfilms Order No. 73-27,936.

Thesis (Ph. D.).

The nuclear magnetic moment and lifetime of the 2.948 MeV (6^+) state of ^{54}Fe were measured. In addition, the magnetic moments of the 4.492 MeV (5^-) and 3.737 MeV (3^-) states of ^{48}Ca were determined along with the lattice location of calcium atoms in iron crystals. Inelastic proton scattering was used to excite the energy levels in both ^{54}Fe and ^{48}Ca. The lifetime of the 6^+ state of ^{54}Fe was determined by a direct timing technique. A value of τ = 1.76 ± 0.03 nsec was obtained. The magnetic moment of the state was measured by a time differential PAC experiment which utilized the internal hyperfine field of Fe (H_{int} = −339 kG). A corresponding g-factor of magnitude |g| = 1.37 ± 0.03 was extracted. These results were found to be in agreement with calculations based on the $(f_{\frac{7}{2}})^J$ proton wave functions used to describe the first 2^+, 4^+, and 6^+ states of ^{54}Fe. A discussion of the use of effective operators in describing the g-factors of such states is also included. In ^{48}Ca, the magnetic moments of the 5^- and 3^- states were determined by time integral IMPACT measurements where the calcium nuclei were recoiled into an iron host and hence experience a strong hyperfine field (H_i = −100 ± 8 kG). An additional measurement of the 5^- g-factor by an external field PAC technique resulted in a value of g_{5^-} = 0.59 ± 0.08 which was nearly twice the value obtained from the IMPACT experiment. Using α particle channelling, an investigation was made of the lattice location of calcium atoms in an iron single crystal. Calcium yields were obtained from beam induced K-shell x-ray production. The results indicate that 50% of the calcium atoms come to rest in substitutional sites while the other 50% are in random interstitial sites. The conclusion drawn from these data is that not all of the calcium nuclei in the IMPACT experiments experience the same hyperfine field. Additional evidence is found for the existence of rapid relaxation processes which act on the calcium nuclei within a time scale of 3 nsec. The 3^- g-factor data was corrected for this effect and a final value of g_{3^-} = 0.44 ± 0.20 was obtained. The g-factors of both the 5^- and 3^- states were in agreement with theoretical calculations based on RPA + deformed component wave functions. (Diss. Abstr. Int., B)

8975 ANALYSIS AND INTERPRETATION OF TOTAL AND CAPTURE CROSS SECTION DATA. Lubert, M. Troy, NY; Rensselaer Polytechnic Inst. (1973). 115p. University Microfilms Order No. 73-27,220.

Thesis (Ph. D.).

A mechanism underlying the correlations between the reduced neutron and the radiative widths for the nickel and chromium isotopes was derived. This theory combines a channel model together with a compound nucleus component. The validity of the model was tested by predicting the (γ,n) cross section for beryllium-9 and carbon-13. The dimensionless reduced widths for ^{57}Fe, ^{53}Cr and ^{61}Ni were obtained by fitting the cross section and partial radiative width data from (γ,n) experiments using R-matrix phase shifts. The thermal (n,γ) cross sections for ^{56}Fe, ^{52}Cr and ^{60}Ni as well as the total radiative widths for several iron, chromium and nickel resonances were obtained. The correlations were attributed to a few strong low lying p-states which have large reduced widths. (Diss. Abstr. Int., B)

8976 BAND MIXING SHELL MODEL CALCULATION FOR ^{47}Ti. Dhar, A. K.; Kulkarni, D. R.; Bhatt, K. H. (Physical Research Lab., Ahmedabad, India). Phys. Lett.; 47B: No. 2, 133-135(29 Oct 1973).

A shell model calculation for ^{47}Ti is done. The state with definite angular momenta projected from the prolate and oblate Hartree–Fock states and a few other intrinsic states obtained from these two HF states by 1 particle–1 hole excitations were used as basis states. The calculated spectrum agrees well with the experimental one. (auth)

8977 STUDY OF LOW-LYING LEVELS OF ^{53}Fe. Nelson, R. O. (North Carolina State Univ., Raleigh); Gould, C. R.; Tilley, D. R.; Roberson, N. R. Nucl. Phys., A215: No. 3, 541-556(1973).

Spins, parities, spectroscopic factors and decay properties were examined for 11 states of ^{53}Fe. Angular distributions were measured for the ^{54}Fe(p,d)^{53}Fe reaction at 29 MeV to determine l-values and spectroscopic factors. The ^{50}Cr(α,nγ)^{53}Fe reaction was used to determine spins, mixing ratios and lifetimes. The combined results allow J^π assignments of $\frac{3}{2}^-$, $\frac{5}{2}^-$, $\frac{7}{2}$ and $\frac{3}{2}^-$ for levels at 741, 1423, 1696 and 2043 keV, respectively. Spectroscopic amplitudes and γ-ray transition rates for low-lying $\frac{7}{2}^-$, $\frac{5}{2}^-$ and $1\frac{1}{2}^-$ states are compared with the predictions of $(f_{\frac{7}{2}})^{-4}$ shell-model calculations. (auth)

8978 INFLUENCE OF THE PAULI OPERATOR ON THE DENSITY DISTRIBUTION IN THE BRUECKNER–HARTREE–FOCK APPROACH IN ^{48}Ca. Faessler, A. (Kernforschungsanlage, Juelich, Ger.); MacKellar, A. D.; Tripathi, R. K. Nucl. Phys., A215: No. 3, 525-531(1973).

Brueckner-Hartree-Fock calculations are done treating the Pauli operator in the self-consistent basis. In addition the rearrangement terms coming out of a variational principle are also studied. The self-consistent Pauli operator decreases the absolute value of the single particle energies by about 10% and the rearrangement term decreases the single particle energy further by 12 to 20% for ^{40}Ca assuming an average energy denominator. The total decrease in the peak of the charge density distribution is about 15%. The Yale force was used for the numerical calculations. (auth)

8979 PROTON–NEUTRON CORRELATIONS IN NUCLEI WITH N = 30. Horie, H. (Tokyo Inst. of Tech.); Ogawa, K. Nucl. Phys., A216: No. 2, 407-428(1973).

Structure of the nuclei with N = 30 and Z = 20–28 is investigated by the nuclear shell model within the proton-neutron configurations $(1f_{\gamma})^{7}_{p}{}^{-20} \times (2p_{\frac{3}{2}}, 2p_{\frac{1}{2}}, 1f_{\frac{5}{2}})^{2}_{n}$. Effective proton-neutron interactions determined by a least-squares fit to the observed spectra of N = 29 nuclei are adopted. Agreement of the calculated spectra with experimental spectra is satisfactory. Strong correlations between protons and neutrons break down the pairing scheme and lower the first J = 2 levels in doubly even nuclei, which is shown from the resultant wave functions. A relation between the shell model and collective rotational model is discussed concerning the calculated rotation-like spectrum of ^{56}Fe. Electromagnetic properties and spectroscopic factors of single-nucleon transfer reactions are calculated. They are in good agreement with experiments. (auth)

8980 METHOD FOR CALCULATION OF STRIPPING FORM FACTORS IN CCBA. Gareev, F. A. (Joint Inst. for Nuclear Research, Dubna, USSR); Yamaleev, R. M.; Schulz, H.; Bang, J. Nucl. Phys., A215: No. 3, 570-580(1973).

A method for the calculation of form factors for stripping reactions on nuclei having vibrational-like states is presented. In the final state wave function the interaction of the transferred neutron with the collective motion of the target nucleus is taken into account. In order to expand the final state function in terms of the target wave function plus single particle wave function, the Sturmian functions are employed. The form factors obtained are used in DWBA and CCBA calculations for the description of the ^{52}Cr(d,p)^{53}Cr reaction. The results indicate that CCBA with these more realistic form factors leads to a considerably improved agreement with angular distributions and spectroscopic factors as compared with DWBA (well depth form factor). (auth)

8981 FINITE RANGE CORRECTIONS FOR TWO-NUCLEON TRANSFER REACTIONS. Dobes, J. (Inst. for Nuclear Physics, Rez, Czech.). Nucl. Phys., A215: No. 3, 581-590(1973).

Finite range corrections in two-nucleon transfer reactions of the type (t,p) or (^{3}He,p) are investigated by means of local WKB theory. A more complete form for the transition potential is used than that used previously. A method convenient for practical calculations is developed and results for the reactions ^{40}Ca(t,p)^{42}Ca and ^{58}Ni(p,t)^{56}Ni are presented. Finite range effects are found to be substantial. (auth)

8982 RADIATIVE CAPTURE OF LOW-ENERGY NEUTRONS IN THE SHELL-MODEL APPROACH TO NUCLEAR REACTIONS. Boridy, E. (Univ., Liege); Mahaux, C. Nucl. Phys., A215: No. 3, 605-616(1973).

The shell-model approach to photonuclear reactions is applied to the radiative capture of low-energy neutrons. The direct, compound and channel resonant contributions to the collision matrix appear in a natural way. It is shown that the experimental data in the vicinity of the 3s giant resonance can be quantitatively interpreted in terms of the channel resonant capture. The relation with the R-matrix approach of Lane and Lynn is discussed. (auth)

8983 BUBBLE NUCLEI. Krishnan, R. M.; Pu, W. W. T. (North Texas State Univ., Denton). Phys. Lett.; 47B: No. 3, 225-226(12 Nov 1973).

The stability of bubble shaped nuclei against symmetry preserving breathing deformations was investigated using the energy density formalism. It is found that the energy is a minimum for bubble shapes when the fissibility parameter is large. These correspond to nuclei with very large mass numbers. (auth)

8984 ONSET OF DIFFRACTION-LIKE ANGULAR DISTRIBUTIONS IN THE ^{40}Ca(^{13}C,^{12}C)^{41}Ca REACTION. Bond, P. D.; Garrett, J. D.; Hansen, O.; Kahana, S.; LeVine, M. J.; Schwarzschild, A. Z. (Brookhaven National Lab., Upton, NY). Phys. Lett.; 47B: No. 3, 231-233(12 Nov 1973).

The angular distribution of the ^{40}Ca(^{13}C,^{12}C)^{41}Ca(g.s.) reaction was measured at incident energies of 60 and 68 MeV. Oscillations in the differential cross section were observed at these energies but not at previously measured, lower energies of 40 and 48 MeV. Arguments are presented which indicate that diffraction-like angular distributions are a systematic feature of heavy-ion reactions. (auth)

8985 IMPROVEMENTS IN THE FORM FACTORS FOR HEAVY-ION TRANSFER REACTIONS. Bouldin, D. P.; Goldfarb, L. J. B. (Univ. of Manchester, Eng.). Phys. Lett.; 47B: No. 3, 203-204(12 Nov 1973).

Calculations are made to show that it is sufficient to use the asymptotic form of one of the transferred nucleon bound-state wave functions in the form factor as long as the strength of the imaginary part of the optical-model potentials is characteristic of that used for elastic scattering. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 7774, 8715, 8936, 8954, 8975, 8979, 8982, 8985, 9004, 9008, 9015, and 9058.

8986 (ANL-8035, pp 60-62) TRANSFER REACTIONS INDUCED ON ^{88}Sr BY ^{16}O. Anantaraman, N.; Katori, K.; Koerner, H. J. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8987 MAGNETIC MOMENT OF THE ISOMERIC $^{9}/_{2}^{+}$ STATE IN ^{67}Zn. Bertschat, H.; Leithaeuser, U.; Maier, K. H.; Recknagel, E.; Spellmeyer, B. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys., A215: No. 3, 486-492(1973).

The isomeric 605 keV, $^{9}/_{2}^{+}$ state in ^{67}Zn was populated by means of the nuclear reaction ^{64}Ni(α,n). The half-life was measured to be $T_{\frac{1}{2}}$ = 333(14) ns and the magnetic moment was determined with the pulsed beam PAD method as $\mu = -1.094(9)$ n.m. These results are compared with half-lives and moments of corresponding $^{9}/_{2}^{+}$ neutron states in ^{67,69,71,73}Ge. (auth)

8988 g-FACTORS OF THE FIRST EXCITED STATES IN ^{78}Br AND ^{80}Br. Pleiter, F.; Bertschat, H.; Recknagel, E.; Spellmeyer, B. (Hahn-Meitner-Institut fuer Kernforschung, Berlin). Nucl. Phys., A215: No. 3, 471-476(1973).

Low-lying states of the doubly odd Br isotopes were populated by means of the nuclear reactions ^{78,80,82}Se(p,n)^{78,80,82}Br. The g-factors of the first excited 2^{-} states in ^{78}Br and ^{80}Br were measured with the pulsed beam DPAD method and were found to be $g(^{78}\text{Br}) = -0.56 \pm 0.02$ and $g(^{80}\text{Br}) = -0.83 \pm 0.06$. (auth)

8989 USE OF GERMANIUM DETECTORS OF γ-RADIATION FOR THE INVESTIGATION OF INELASTIC SCATTERING OF NEUTRONS. Konobeevskii, E. S.; Zhits, M. M.; Musaelyan, R. M.; Popov, V. I.; Popov, N. V.; Surkova, I. V.; Shgranikh, I. V. Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 100-106(1972). (In Russian).

The inelastic scattering of neutrons with energies of ~1.5 MeV was investigated with Ge γ-radiation detectors. The measurement of γ-quanta spectra and cross sections of excited nuclear levels is discussed. Cross section data are presented for excited levels of even Ge isotopes. (tr-auth).

8990 EXCITED STATES OF Kr AND Rb ISOTOPES IN THE 78 ≤ A ≤ 85 MASS REGION. Broda, R. (Inst. of Nuclear Physics, Krakow); Hrynkiewicz, A. Z.; Styczen, J.; Walus, W. Nucl. Phys.; A216: No. 3, 493-518(1973).

The excited states of the ^{78,80,81}Kr and ^{80,81,83}Rb nuclei were investigated in radioactive decays of the respective Rb and Sr isotopes. The level schemes were established and for a number of levels the spin–parity assignments were suggested on the basis of the log-ft values and γ-branching ratios, as well as in some cases angular-correlation results. The structures of excited states of the odd Kr, odd Rb, and doubly even Kr isotopes are compared and discussed in the framework of existing theoretical approaches. (auth)

8991 PARTICLE–PHONON MODEL AND PARTICLE–CORE MODEL FOR ^{63}Cu. De Jager, J. L.; Boeker, E. (Vrije Univ., Amsterdam). Nucl. Phys.; A216: No. 2, 349-364(1973).

The accuracy of the particle–phonon and particle–core models in describing the properties of ^{63}Cu is studied. From the measured properties of the low-lying levels, adopted values and uncertainties are deduced, which are used to obtain the model parameters by fitting procedures. The influence of a change in the excitation energy of the $(^{3}/_{2})^{-}$ level is investigated. It is seen that the particle–phonon model cannot reproduce the properties of ^{63}Cu as good as the particle–core model, although the former has a much larger configuration space. The quadrupole moment of the ^{62}Ni 2^{+} core state in the particle-core model is calculated as +25 e·fm^{2}. (auth)

8992 CONVERSION SPECTRUM OF ^{88}Sr. Metskhvarishvili, R. Ya.; Elizbarashvili, M. A.; Bodokiya, L. V. Soobshch. Akad. Nauk Gruz. SSR; 72: No. 1, 57-60(Oct 1973). (In Russian).

The spectrum of conversion electrons created in the decay of ^{88}Y was investigated by using a sector-type double-focusing β spectrometer. The intensity of the K line for the 2735-keV γ transition was measured for the first time, and K and L conversion lines were separated for the 1836-keV γ transition. Relative intensities of all observed conversion lines were measured. A weak K-line was discovered, the energy of which enabled the assumption that there may exist a γ transition with an energy of 1760 keV. The presence of this transition points to the population of the 3598-keV level in the decay of ^{88}Y. The α_K coefficients for the 1836- and 2735-keV transitions and the α_L coefficients for the 898- and 1836-keV transitions were determined. (3 figures, 2 tables) (auth)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 8936, 8954, 9004, 9021, 9043, and 9058.

8993 (AECL-4596) PROGRAM FOR NUCLEAR PHYSICS IN THE SEVENTIES AND BEYOND. Hardy, J. C.; McDonald, A. B.; Milton, J. C. D. (eds.). (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Sep 1973. 125p. Dep. NTIS (U. S. Sales Only) $8.25. AECL $2.50.

A possible research program for the Nuclear Physics Branch in the second half of this decade and beyond is discussed—a program which, if followed, would undoubtedly expand the boundaries of knowledge several fold; but more than that, a program that seems likely to lead to fundamentally new and exciting discoveries. The core of the discussion reviews the prospects in nine major areas: nuclei far from the region of beta stability, superheavy nuclei, fission, in-beam studies of electromagnetic properties, heavy-ion scattering, transfer reactions with heavy ions, studies with light-ion beams, ranges and stopping powers of heavy ions and atomic collisions, and fundamental interactions and symmetries. The future looks very bright in fields which could be studied with higher-energy beams, particularly of heavy ions. Then the types of beams and the energy and resolution required to carry out all aspects of the proposed programs are specified, and lead to the conclusions that a desirable accelerator would be able to produce beams of all ions from hydrogen to uranium with energies variable up to 300 MeV for hydrogen and 10 MeV/nucleon for uranium, with a resolution of 0.01%. A brief discussion is given of three possible additions to the MP Tandem that would meet all these requirements. The final chapter reviews the experimental equipment and data handling facilities that would be necessary to carry out the proposed program in an efficient manner. Much of this ancilliary equipment already exists at the MP Tandem installation. (auth)

8994 (ANL-8035) PHYSICS DIVISION ANNUAL REVIEW, 1 APRIL 1972–31 MARCH 1973. (Argonne National Lab., Ill. (USA)). 1973. Contract W-31-109-eng-38. 232p. Dep. NTIS $7.60.

A comprehensive picture of the work of the Physics Division in the year ending in the spring of 1973 is presented. Research in the following areas is included: experimental low-energy nuclear physics, medium-energy physics, theoretical physics, and experimental atomic physics. Lists of publications (25 pages) and staff members are also given. (RWR)

For title listings of selected papers see: 8342, 8902, 8917, 8918, 8963–8967, 8986, 8995–8998, 9019, 9020, 9040, and 9041.

8995 (ANL-8035, pp 13-14) AVERAGE RESONANCE NEUTRON CAPTURE LEADING TO LEVELS IN ^{113}Cd AND ^{114}Cd. Smither, R. K.; Thomas, G. E.; Bollinger, L. M. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8996 (ANL-8035, pp 13-17) LEVEL STRUCTURE OF THE ODD-A ISOTOPES OF Sm. Smither, R. K.; Thomas, G. E. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8997 (ANL-8035, pp 62-63) ^{16}O-INDUCED REACTIONS ON ^{124}Sn. Katori, K.; Fink, C. L.; Yntema, J. L. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8998 (ANL-8035, pp 86-88) LEVELS IN ^{97}Nb BY MEANS OF THE ^{96}Zr(^{3}He,d) REACTION. Medsker, L. R.; Schiffer, J. P. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

8999 (COO-1265-142, pp 142-146) QUASI-ELASTIC (p,n) REACTION TO THE ISOBARIC ANALOG STATE OF ^{119}Sn FOLLOWED BY PROTON EMISSION. Fitzgerald, D. H.; Greenlees, G. W.; Lilley, J. S.; Moss, J. M.; Woods, T. J. Sep 1973.

In annual report, 1973.

9000 (JINR-E4-7422) EVIDENCE FOR ROTATIONAL-LIKE STRUCTURE IN ^{117}Sb. Fromm, W. D.; Brinckmann, H. F.; Heiser, C.; May, F. R.; Rotter, H.; Pashkevich, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

In the decay of the isomeric $25/2^+$ state in ^{117}Sb a quasirotational band was observed and interpreted to belong to the $9/2^+$ [404] Nilsson orbital. This assignment is mainly based on the analysis of the measured cascade/crossover intensity ratios. The calculated equilibrium deformation energies support the derived deformation value of $\epsilon = +0.22$. (auth)

9001 (JINR-P6-7272) DELAYED PROTON EMITTER ^{113}Ba. Bogdanov, D. D.; Karnaukhov, V. A.; Petrov, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

In the ^{106}Cd(^{16}O,3n) reaction there was obtained a new delayed proton emitter, ^{113}Ba. Identification was performed through the excitation function. The half-life, $T_{\frac{1}{2}} = (5.0 \pm 0.6)$ s, and the proton spectrum were measured. From the comparison of the spectrum shape with that calculated by using the statistical model, there was obtained the total energy value for electron capture, $Q_0 = (7.1 \pm 1.0)$ MeV. (3 figures, 1 table) (auth)

9002 (JINR-P-15-7383) INVESTIGATION OF RADIATIVE PROTON CAPTURE ON ^{110}Cd IN THE ENERGY RANGE OF 2 TO 4.5 MeV. Brzosko, J.; Gierlik, E.; Piotrowski, J.; Soltan, A.; Szeflinski, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The abnormally intensive high-energy part of the γ-spectra (emitted from nuclei at $E_x = 6-10$ MeV) is due to single-particle transitions. Its role was analyzed in common-doorway states by A. M. Lane and in compound nucleus exit states by J. S. Brzosko et al. The measurement results of population of the known levels in ^{111}In with excitation energy $E_x \leq 2.3$ MeV are presented. A typical measured γ-spectrum as well as the scheme of known ^{111}In levels are given. The excitation function of the ^{110}Cd(p,γ)^{111}In reaction is presented. The isomeric ratio and the decay intensities for the particular levels, normalized to the total number are shown. It is emphasized that among 22 known levels of ^{111}In nucleus only 8 play an important role as intermediate levels in γ-ray cascade. Coefficients of correlations between the relative populating intensities for these levels are 0.7 to 0.8 in the compound nucleus excitation energy range from 7.3 to 9.8 MeV. The role of the levels lying above 2.3 MeV in the population of the metastable and ground states is presented. The predictions based on the compound nucleus theory are given. From analysis it may be expected that the observed strong deviations from the predictions of the pure statistical model ($b = 0$) are due to the exit configurations. The exit configurations may populate selected low-lying levels, whose wave functions include similar components. The possible candidate is $|(\pi f_{\frac{1}{2}}, 12)_{\frac{1}{2}}-$ the $f_{\frac{1}{2}}$ proton coupled with the 2^+ excited ^{110}Cd core. (auth)

9003 (NP-19872) ANNUAL REPORT, 1971. (Saha Inst. of Nuclear Physics, Calcutta (India)). 1971. 227p. Dep. NTIS (U. S. Sales Only) $13.50.

A general summary of the work of the institute this year is given in the introduction. Detailed reports, arranged by groups and divisions, are then presented as follows: Accelerator group (Cyclic accelerator division, Electrostatic accelerator division, Nuclear chemistry division, Mass spectroscopy and isotope separator division), Nuclear physics group (Nuclear physics division, Crystallography and molecular biology division, Teaching division), Biophysics division, Theoretical nuclear physics division, Instrumentation division, Director's research group, and Workshop. Lists of publications and staff members and budgetary information are also included. (RWR)

9004 (ORNL-4923) RADIOACTIVE ATOMS: SUPPLEMENT I. Martin, M. J. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 33p. Dep. NTIS $4.00.

Decay schemes and decay data are presented for 15 radioactive atomic species of special importance in the monitoring of reactor effluents. In addition to the nuclear radiations required for this purpose, there are listed the atomic radiations of additional importance to workers in the fields of nuclear medicine and health physics. Listed in tabular form are "best" values for half-lives, energies, intensities, equilibrium absorbed-dose constants, and 90% absorbed-dose ranges (in water) for each of the atomic and

nuclear radiations emitted by these radioactive species. The basic data from which the "best" values were chosen, along with literature references, are also given. All data received before August 1, 1973, were included. (auth)

9005 MEASUREMENT OF THE CROSS-SECTION FOR THE $^{115}In(n,n')^{115m}In$ REACTION. Kobayashi, K. (Kyoto Univ.); Kimura, I.; Gotoh, H.; Yagi, H. J. Nucl. Energy; 27: No. 10, 741-745(Oct 1973).

The energy dependent cross section for the $^{115}In(n,n')^{115m}In$ reaction was measured in the neutron energy region from 3.37 to 4.89 MeV with a 2 MeV van de Graaff accelerator. A pair of semiconductor proton recoil counters composed of a polyethylene radiator and a silicon detector was used for the absolute measurement of the neutron flux at the indium sample. A comparison of the average cross section, 175 ± 6 mb, which was measured with a fission plate, with the average cross section calculated with the energy dependent cross section and the Maxwellian fission neutron spectrum is presented and discussed. (auth)

9006 γ-γ DIRECTIONAL CORRELATION MEASUREMENTS IN ^{106}Pd. Sato, Y.; Azuma, T. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 45-48(1972).

In a study of ^{106}Pd levels γ-γ directional correlations were measured through the decay of ^{106m}Ag by using the Ge(Li)-Ge(Li) coincidence system. The E2/M1 mixing ratios for the 616-keV and 1045-keV transitions were determined. The spins of the 2077-keV and 2365-keV levels were assigned to be 4. (3 figures, 2 tables) (auth)

9007 ELECTRIC QUADRUPOLE TRANSITIONS IN ^{120}Sn AND ^{208}Pb. Kamerdzhiev, S. P. (Inst. of Physics and Power Engineering, Obninsk, USSR). Phys. Lett.; 47B: No. 2, 147-151(29 Oct 1973).

Electric quadrupole transitions in ^{120}Sn and ^{208}Pb in the 0-30 MeV energy range have been studied using the finite Fermi-systems theory with the known phenomenological constants. One particle-one hole 2^+ levels were considered. The results are compared with experiment. (auth)

9008 ELASTIC AND INELASTIC SCATTERING OF 14 MeV NEUTRONS. Sato, Y.; Hiraoka, E.; Azuma, T. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 49-51(1972).

14-MeV neutrons scattered from C, Zn, Sn, and Bi were measured by time-of-flight, n-α associated-particle method with neutron pulse shape discrimination. The elastic scattering cross sections for these elements at 40 degrees are 105, 45, 30, and 410 mb, respectively. The inelastic scattering cross sections are 35 (4.43 MeV), 12 (0.92 MeV), 5 (1.15 MeV), and 87 (1.6 MeV) mb, respectively. (6 figures, 3 tables) (auth)

9009 RELATIVE CROSS-SECTION DETERMINATION IN THE CASE OF PERIODIC ACTIVATIONS. Uray, I.; Kovacs, P. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 3, 209-213(1973). (In Hungarian).

Relative cross-section determination by comparing to an internal standard is discussed for the case of periodic activations. The calculation of the deduced cross-section relation is possible by a small computer, too. (1 figure) (auth)

9010 DOUBLE-PHOTON DECAY IN ^{90}Zr NUCLEUS. Asano, Y.; Wu, C. S. (Columbia Univ., New York). Nucl. Phys., A215: No. 3, 557-569(1973).

Double-photon decay in the 0^+ to 0^+ transition in ^{90}Zr was measured with two large-volume Ge(Li) detectors, at angles of 90 and 180°. The branching ratio of double-photon decay with respect to the sum of internal-conversion electrons and internal pairs was $(3.17 \pm 0.77) \times 10^{-4}$. The angular correlation of two photons is in agreement with that of (E1, E1) transition, although it does not exclude other possibilities. (auth)

9011 SEARCH FOR A QUADRUPOLE COMPONENT IN THE HYPERFINE INTERACTION ON RECOIL INTO VACUUM. Spehl, H. (Univ., Frieburg i. B.); Steadman, S. G.; Weckherlin, A.; Doubt, H. A.; Hagemeyer, K.; Kumbartzki, G. J.; Speidel, K. H. Nucl. Phys., A215: No. 3, 446-460(1973).

Time-differential perturbed γ-ray angular correlations were measured with the plunger technique for fast Nd nuclei recoiling into vacuum. A clear trend of increasing quadrupole interaction with increasing nuclear quadrupole moment was found. The hyperfine interaction on recoil into vacuum and recoil into gas is discussed in terms of stochastic models. (auth)

9012 ISOSPIN SPLITTING OF GIANT E1 EXCITATIONS IN ^{90}Zr. Hasinoff, M.; Fisher, G. A.; Hanna, S. S. (Stanford Univ., CA). Nucl. Phys., A216: No. 2, 221-249(1973).

The radiative proton capture reaction was used to study the distribution of the E1 strength in ^{90}Zr from E_x = 13.7 to 25.2 MeV. The reaction $^{89}Y(p,\gamma_0)^{90}Zr$ displays the "normal" $T_<$ giant dipole resonance (GDR) at E_x = 16.5 MeV with a width Γ = 4 MeV. For this resonance the measured γ_0 angular distributions are nearly constant ($a_2 = -0.34$) and are consistent with a predominantly $d_{\frac{5}{2}}p^{-1}_{\frac{1}{2}}$ configuration. Several analogue $T_>$ dipole levels are observed superimposed on the broad $T_<$ GDR and interfere with it in the characteristic manner. Resonance parameters for the $T_>$ E1 levels were derived from a two-resonance interference analysis and the characteristic dipole enhancement for the highest $T_>$ levels is observed. A comparison of the measured and calculated values of Γ_{γ_0} indicates the usual hindrance factor for the low-lying $s_{\frac{1}{2}}p^{-1}_{\frac{1}{2}}$ and $d_{\frac{5}{2}}p^{-1}_{\frac{1}{2}}$ $T_>$ levels. The dominant $d_{\frac{5}{2}}$ strength lies about 0.5 MeV above the $d_{\frac{5}{2}}$ resonance observed in elastic proton scattering. The integrated $^{90}Zr(\gamma,p_0)$ strength is separated into its $T_>$ and $T_<$ components and compared to $^{90}Zr(\gamma,xn)$ and to theoretical predictions based on isospin sum rules. Good agreement between theory and experiment is found. The reaction $^{89}Y(p,\gamma)^{90}Zr^*$ leading to unresolved excited states also reveals both a "normal" $T_<$ GDR and analogue dipole levels, of which the highest ones appear to form a $T_>$GDR. The shift of this $T_<$ GDR relative to the $T_<$ GDR for γ_0 is consistent with the average excitation energy of the low-lying states in ^{90}Zr. The $T_>$ GDR's for both γ_0 and the γ's leading to excited states are shifted above the corresponding $T_<$ GDR's by approximately 4 MeV which leads to a value for the collective potential strength in the Lane potential of V_1 = 57 ± 4 MeV. (auth)

9013 SEARCH FOR DISPERSIVE EFFECTS IN ELECTRON SCATTERING FROM SAMARIUM. Cardman, L. S.; Kalinsky, D.; Legg, J. R.; Yen, R.; Bockelman, C. K. (Yale Univ., New Haven). Nucl. Phys., A216: No. 2, 285-311(1973).

Anomalous results obtained in recent electron scattering experiments suggest that a dispersion correction may contribute significantly to elastic cross sections in the region of the first diffraction minimum. Such a dispersion correction describes the effect of possible virtual nuclear excitations neglected in conventional phase-shift analyses of electron scattering data. To investigate this effect, the Yale University electron accelerator has been used to study the scattering from ^{148}Sm, ^{150}Sm, and ^{152}Sm at 42 and 60 MeV and scattering angles between 70° and 160°. In each case the data can be fit fairly well with a conventional Fermi distribution. For ^{152}Sm the data are in reasonable agreement with an MIT-NBS measurement, and to lower momentum transfers. The same data, however, disagree with the static-theory prediction based on the Columbia muonic X-ray measurements. Data on Nd are re-examined; it is concluded that the anomaly claimed earlier can be reduced by renormalization of the cross sections, but it cannot be entirely removed. (auth)

9014 NEUTRON SPECTRA FROM THE REACTION OF NEGATIVE MUON ABSORPTION BY HEAVY NUCLEI AND THE RESONANCE THEORY OF NUCLEAR REACTIONS. Evseev, V. S.; Mamedov, T. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 18: No. 5, 968-975(Nov 1973). (In Russian).

The neutron spectra from the reaction of μ^--meson absorption in ^{127}I and ^{232}Th are measured in the energy range $1.6 \leq E_n \leq 9.6$ MeV. The low-energy part of the spectrum is used to determine the "temperature" of the nucleus after the emission of first neutron (1.28 ± 0.05 MeV for ^{126}Te and 1.46 ± 0.06 MeV for ^{131}Ac) and density parameter. (auth)

9015 SIMPLE METHOD FOR ESTIMATING MAXIMUM CROSS SECTIONS FOR (α,xn)- and (p,xn)-REACTIONS. Roehm, H. F.; Muenzel, H.; Lange, J. (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instrum. Methods; 113: No. 1, 101-107(1973).

The dependence of the maximum cross section of excitation functions for (α,xn) and (p,xn) reactions, where x = 1 ... 5, on various nuclear properties was investigated. The parameter used to systematize the cross-section maxima, σ_{max}, was derived from the statistical model. Reasonable predictions for σ_{max} could be made by using this parameter. The relative standard deviation of the experimental data used from the systematic trends was less than 40%. Agreement between the trends predicted by theory and those obtained from published data was satisfactory. (5 figures, 2 tables) (auth)

9016 VIOLATION OF P-PARITY IN THE $^{113}Cd(n,\gamma)^{114}Cd$ REACTION. Abov, Yu. G.; Ermakov, O. N.; Krupchitskii, P. A. Zh. Eksp. Teor. Fiz.; 65: No. 5, 1738-1744(Nov 1973). (In Russian).

The results of three experiments on the asymmetry of emission of 9.0 MeV γ quanta in the $^{113}Cd(n,\gamma)^{114}Cd$ reaction induced by a polarized thermal neutron beam are generalized. The weighted mean value of the asymmetry without allowance for the background and admixture of the 8.5 MeV transition is a =

$(-3.3 \pm 0.6) \cdot 10^{-4}$. An estimate of the admixture effect yields the result $a = (-4.1 \pm 0.8) \cdot 10^{-4}$. The results obtained are compared with available results for the same reaction. (auth)

9017 MAGNETIC HYPERFINE ANOMALY IN THE MOESSBAUER ISOTOPE ^{119}Sn. Williams, J. M.; Brooks, J. S. (Univ. of Sheffield, Eng.). Phys. Lett.; 45A: No. 4, 335-336(8 Oct 1973).

The ratios of the nuclear g factors in a uniform applied field by using the Moessbauer effect in ^{119}Sn were measured. A hyperfine anomaly $^1\Delta^2 = (5.9 \pm 2.0)\%$ was obtained, which is thought to be near the purely contact value. A new value of $\mu_e = +0.643(9)$ nm is given. (auth)

9018 COMPOUND NUCLEAR REACTION TIMES AND LEVEL DENSITIES FROM A BLOCKING EXPERIMENT IN MOLYBDENUM. Fuschini, E. (Univ., Bologna); Massa, I.; Uguzzoni, A.; Verondini, E.; Petty, R. J.; Clark, G. J. Nuovo Cim.; 18A: No. 3, 416-426(1 Dec 1973).

The ⟨111⟩ axial blocking in a natural Mo crystal was used to measure the ^{92}Mo(p,p')^{92}Mo* (1.5 MeV, 2^+) reaction times at proton energies between 7.5 and 9.5 MeV. A computer simulation was employed to extract the mean reaction times which were found to range from $2 \cdot 10^{-17}$ to $4 \cdot 10^{-17}$ s with an accuracy of 15%. An analysis of the results has allowed us to extract the value $a = (10.06 \pm 0.12)$ (MeV)$^{-1}$ for the level density parameter of the compound nucleus ^{93}Tc in the excitation energy range from 11.5 to 13.5 MeV. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 8650, 8690, 9011, 9013, 9015, 9031, 9043, 9058, and 9070.

9019 (ANL-8035, pp 18-20) LEVEL SCHEMES OF ^{178}Hf AND ^{180}Hf. Smither, R. K.; Bushnell, D. L.; Buss, D. J. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

9020 (ANL-8035, pp 62; 64-65) ^{16}O-INDUCED TRANSFER REACTIONS ON ^{172}Yb. Koerner, H. J.; Jones, K. W.; Siemssen, R. H.; Schiffer, J. P.; Schwarzschild, A. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

9021 (COO-1265-142, pp 105-110) SHAPE TRANSITION OBSERVED IN THE ODD-MASS Eu ISOTOPES BY THE (p,t) REACTION. Taketani, H.; Sharma, H. L.; Hintz, N. M. Sep 1973.

In annual report, 1973.

9022 (COO-1265-142, pp 112-116) ^{166}Er(d,p)^{167}Er REACTION. DeLong, R.; Dehnhard, D. Sep 1973.

In annual report, 1973.

9023 EFFECTS OF THE MICROSCOPICAL THEORY OF THE CORIOLIS FORCES ON NUCLEAR BETA-DECAY ^{155}Eu → ^{155}Gd. Bogdan, D. (Institutul de Fizica Atomica, Bucharest); Cretu, C.; Macarie, G.; Chernei, M. I. Z. Phys.; 263: No. 2, 121-128(1973).

The wave functions yielded by the microscopical nonadiabatic treatment of the Coriolis interaction proposed in Dubna by Pyatov, Chernej and Baznat were used in order to calculate the beta decay observables of some allowed transitions of the ^{155}Eu nucleus. The Coriolis interaction effects are important especially for the absolute ft values (an important improvement is obtained) and for the $\beta-\gamma$ circular polarization correlation. (GE)

9024 MEASUREMENTS OF E4 MATRIX ELEMENTS IN ^{152}Sm AND ^{154}Sm. Ebert, W.; Hecking, P.; Pelz, K.; Steadman, S. G.; Winkler, P. (Erlangen-Nuernberg Univ., Erlangen, Ger.). Z. Phys.; 263: No. 3, 191-200(1973).

The E4 transition matrix element from the ground state to the 4^+ state was measured in ^{152}Sm and ^{154}Sm, by comparing relative thick target γ-ray intensities following Coulomb excitation with 12 MeV ^{4}He, 24 to 30 MeV ^{16}O, and 35 to 40 MeV ^{32}S projectiles. Values for the E4 matrix element of $(+0.31 + 0.12 - 0.20)$ barn^2 in ^{152}Sm and $(+0.50 + 0.09 - 0.12)$ barn^2 in ^{154}Sm are found. (GE)

9025 HIGH SPIN STATES IN THE TRANSITIONAL NUCLEUS ^{156}Er. Beuscher, H.; Davidson, W. F.; Lieder, R. M.; Mayer Boericke, C.; Ihle, H. (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 263: No. 3, 201-210(1973).

High-spin states in ^{156}Er were populated using the $(\alpha,8n)$ and $(^{16}O,4n)$ reactions. In the ground state band a strong back bending effect was observed at $I^\pi = 12^+$. Four states of a second $K = 0$ band spins 9, 11, 13 and 15 were found. This second band depopulates completely into the 8^+ and 10^+ members of the ground state band. This is explained by the fact that the upper states of this second band are yrast states and that this band crosses the (gsb)-line at $I \approx 11$. (GE)

9026 PRECISION MEASUREMENT OF THE HYPERFINE STRUCTURE OF ^{175}Lu WITH THE ATOMIC BEAM MAGNETIC RESONANCE METHOD. Figger, H.; Wolber, G. (Univ., Bonn). Z. Phys.; 264: No. 2, 95-108(1973).

The hyperfine structure separations of both doublet states $^2D_{3/2}$ and $^2D_{5/2}$ of the ground state configuration $6s^25d$ of ^{175}Lu were remeasured with high precision using the atomic beam magnetic resonance method. Magnetic dipole transitions between Zeeman components of the hfs levels were induced applying Ramsey's technique of separated oscillatory fields whenever the field dependence of the resonances were small enough. The hfs intervals at zero field and hfs interaction constants were derived from the measurements. The constants were then corrected for hfs perturbations between the two levels of the doublet. The configuration interaction was taken into account for the calculation of the dipole matrix elements. (GE)

9027 GAMMA TRANSFERS OF DECOMPOSITION OF ^{169}Yb–^{169}Tm WITH AN ENERGY EXCEEDING 30 keV. Georgieva, M. K.; Misheva, M. A.; Tumbev, G. H. (Inst. of Physics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 26: No. 5, 623-626(1973). (In Russian).

In gamma spectra determined for the ^{169}Yb–^{169}Tm decay, besides the peaks corresponding to the expected gamma transitions, there were peaks apparently due to fortuitous coincidence of certain pulses. Six transitions between 465 and 710 keV are mentioned which were not found, and two more were only weakly expressed. Analysis of spectra in the energy range below 300 keV did not suggest any previously unnoted transitions. (TTT)

9028 ELECTRON SCATTERING STUDIES OF ^{184}W AND ^{186}W. Kalinsky, D.; Cardman, L. S.; Yen, R.; Legg, J. R.; Beckelman, C. K. (Yale Univ., New Haven). Nucl. Phys., A216: No. 2, 312-334(1973).

Anomalous results obtained in recent electron-nucleus scattering experiments suggest that a dispersion correction may contribute significantly to elastic cross sections in the region of the first diffraction minimum. Such a dispersion correction describes the effect of possible virtual nuclear excitations neglected in the conventional phase-shift analyses of electron scattering data. To investigate these effects, the Yale University electron accelerator was used to study the scattering from ^{184}W and ^{186}W at incident energies between 40 and 65 MeV and scattering angles between 70° and 150°. No evidence of a dispersion effect is seen in the nucleus ^{186}W. In the case of ^{184}W, a comparison of the measured cross sections with those expected on the basis of the results of muonic X-ray experiments indicates that any dispersive effect is limited to less than 10% in the region of the first diffraction minimum. A summary of the results of this laboratory's search for dispersion effects in Nd, Sm, and W is appended. (auth)

9029 SIMPLIFIED CALCULATION OF PARITY NON CONSERVING E1 TRANSITIONS IN THE OSCILLATOR SHELL MODEL. Desplanques, B. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 47B: No. 3, 212-214(12 Nov 1973).

Contributions of excitations of the neutron core to the circular polarization of γ emitted in the transition $^5/_2^+ \rightarrow {}^7/_2^+$ in ^{181}Ta are calculated. It is shown in a very simple model that these contributions are coherent and multiply by a factor 2 the polarizations calculated previously with proton–neutron parity-violating potentials. (auth)

9030 CENTRIFUGAL STRETCHING IN ^{158}Er. Nair, S. C. K. (Hahn-Meitner-Institut fuer Kernforschung, Berlin); Ansari, A. Phys. Lett.; 47B: No. 3, 200-202(12 Nov 1973).

A variational calculation after an approximate angular momentum projection for ^{158}Er indicates that the anomalous behavior of the energy spacings of high spin states may be due to centrifugal stretching—an increase in deformation accompanied by a decrease in pairing correlations. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 8740, 8934, 8937, 8954, 9007, 9008, 9015, 9058, and 9089.

9031 (COO-1265-142, pp 114; 117-122) STUDY OF THE SHAPE TRANSITIONS AND POSSIBLE TWO-PHONON GAMMA VIBRATIONS IN THE OSMIUM REGION BY (p,t) REACTIONS. Sharma, H. L.; Hintz, N. M. Sep 1973.

In annual report, 1973.

9032 (COO-1265-142, pp 123-130) NUCLEAR MATTER DENSITY OF ^{209}Bi FROM α-SCATTERING. Lilley, J. S. Sep 1973.

In annual report, 1973.

9033 (COO-1265-142, pp 152-156) ENERGY DEPENDENCE OF THE CHARGE-EXCHANGE COMPONENT OF THE OPTICAL POTENTIAL. Woods, T. J. Sep 1973.

In annual report, 1973.

9034 (JINR-E6-7289) DECAY OF THE i13/2 ISOMERIC STATES IN THE ^{199}Po AND ^{201}Po ISOTOPES. Korman, A.; Chlebowska, D.; Haratym, Z.; Kempisty, T.; Nguyen Tat To; Chojnacki, S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

The β^+−EC decays of isomeric states in the ^{199,201}Po isotopes produced in the reaction Au(^{10}B,xn)^{199,201}Po were investigated. On the basis of the simple γ spectra, γ-γ coincidence, and conversion electron measurements, the decay schemes of ^{199m}Po and ^{201m}Po isomeric states are presented. The experimental data and the results of theoretical calculations are compared. (auth)

9035 (JINR-E6-7392) HIGHLY EXCITED ISOMERIC STATES IN ^{199}Bi AND ^{201}Bi. Gippner, P.; Kaun, K. H.; Neubert, W.; Stary, F.; Schulze, W. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Isomeric states with half-lives $2\mu s \leq T_{\frac{1}{2}} \leq 50\mu s$ excited by the reactions ^{191}Ir(^{12}C,4n)^{199m}Bi and ^{193}Ir(^{12}C,4n)^{201m}Bi have been observed. The ^{199}Bi isomer decays via the levels of 1922.5 keV, 1776.9 keV, 1502.3 keV (13/2⁻), 1002.5 keV (11/2⁻), and the ^{201}Bi isomer does via the levels of 1836.6 keV, 1651.1 keV (15/2⁻), 1379.1 keV (13/2⁻), 967.1 keV (11/2⁻) to the 9/2⁻ ground states. These levels may be explained by the coupling of an $h_{\frac{9}{2}}$ proton to the corresponding ^{198,200}Pb core states 2^+ and 4^+. (auth)

9036 (JINR-P2-7264) POSSIBLE UNIFIED DESCRIPTION OF NUCLEAR LEVELS AND SCATTERING OF α-PARTICLES AND ELECTRONS. Afanas'ev, G. N.; Eliseev, S. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

An attempt is made to describe nuclear levels and the scattering of α particles and electrons by nuclei in the framework of the unified model. The problems of connection between the one-particle potential and density in nuclei are discussed. (11 figures) (auth)

9037 NEW ISOMER IN ^{205}Po. Focke, B.; Goldmann, A.; Hadijuana, J.; von Hartrott, M.; Nishiyama, K.; Riegel, D. (Freie Univ., Berlin). Z. Phys.; 259: No. 3, 269-273(1973).

A new isomer with $T_{\frac{1}{2}} = 58 \pm 2$ ms was observed in ^{205}Po. The assignments $I^\pi = 13/2^-$ and an excitation energy $E_x = 1.461$ keV are proposed. (GE)

9038 NEW ISOTOPE ^{188}Ir AND OTHER PRODUCTS OF THE FAST NEUTRON REACTIONS OF ^{198}Pt. Uray, I. ATOMKI (At. Kut. Intez.) Kozlem.; 15: No. 3, 161-182(1973). (In English).

In studies on the fast-neutron reactions of ^{198}Pt, the half-life of ^{197m}Pt was found to be (94.4 ± 0.8) min. The half-life of ^{199m}Pt was (13.3 ± 0.2) s, and the energy of the $13/2^+ \rightarrow 1/2^-$ transition was found to be (391.93 ± 0.14) keV. The isomeric cross-section ratio, relating to the (n,γ) reaction at the given neutron energy, was 0.081 ± 0.037. For the cross sections of the (n,d) + (n,np) and (n,α) reactions, an upper limit estimate is given. The half-life of the new isotope ^{188}Ir was (8 ± 3) s (max error). The energy of the $2_1^+ \rightarrow 0^+$ transition, belonging to ^{188}Pt and appearing during the decay of ^{188}Ir, was (407.76 ± 0.22) keV, and the partial activation cross section of the transition amounted to (0.3 ± 0.1) mb. (10 figures, 4 tables) (auth)

9039 ANALYZING POWERS IN ^{206}Pb(p VECTOR, t)^{206}Pb TRANSITIONS. MacDonald, J. A.; Jelley, N. A.; Cerny, J. (Univ. of California, Berkeley). Phys. Lett.; 47B: No. 3, 237-240(12 Nov 1973).

A 40-MeV polarized proton beam was used to induce ($\vec{p}$,t) transitions to the lowest 0^+, 2^+, 4^+ and 6^+ states in ^{206}Pb. The analyzing power of the L = 0 transition was well fit by zero-range DWBA, but only qualitative agreement was obtained for the L = 2, 4 and 6 transitions. (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 7694, 8486, 8983, and 9014.

9040 (ANL-8035, pp 97-99) TWO-QUASIPARTICLE STATES IN ACTINIDE NUCLEI. Katori, K.; Friedman, A. M.; Chasman, R. R.; Erskine, J. R. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

9041 (ANL-8035, pp 102-103) COUPLED-CHANNEL CALCULATIONS FOR SUB-COULOMB TRANSFER REACTIONS ON ACTINIDE NUCLEI. Erskine, J. R.; Tamura, T. 1973.

In Physics Division annual review, 1 April 1972–31 March 1973.

9042 (JINR-P1-7443) ^{239}Pu FISSION BY NEGATIVE MUONS. Evseev, V. S.; Mamedov, T. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The neutron spectrum was measured from the reaction of μ-capture in ^{239}Pu in the energy range of 2.4 to 10 MeV. There was determined the absolute neutron yield per one act of μ-meson stopping Δn (prompt + captured) in the energy range of 2.6 to 8.6 MeV. According to the known Δn and the mean number of neutrons $\bar{\nu}$ for ^{239}Pu fission and also according to the known ratio of prompt and delayed neutrons at the μ-meson stopping in ^{239}Pu, for the first time, there was determined the absolute probability of prompt fission (due to atomic radiationless μ-meson transition) per one stopped muon: $W_{rd.\ fis.} = 0.21 + 0.04$, as well as the absolute probability of delayed fission per one μ-meson stop: $W_{del.\ fis.} = 0.47 + 0.18$, and the limits of fission probability per a capture act $0.74 + 0.18$ $W_{del.\ fis.} = 0.94 + 0.23$. (auth)

9043 CHARGE DISTRIBUTION IN NEUTRON-INDUCED FISSION OF THORIUM AND ISOMERIC YIELD AND CROSS-SECTION RATIOS. Rao, S. R. Fayetteville, AR; Univ. of Arkansas (1973). 101p. University Microfilms Order No. 73-27,396.

Thesis (Ph. D.).

Mass and charge-distribution were studied in the neutron induced fission of thorium. Independent-fission yields of $^{95m+g}$Nb, ^{96}Nb, ^{99m}Tc, ^{106}Rh, ^{112}Ag, ^{115m}In, ^{117}In, ^{130}I, ^{132}I, ^{133}I, ^{134}I, ^{134m}Cs, and ^{135m}Cs, and fission yields of four mass chains in the symmetric region A = 111 to 115 were determined in the fission of ^{232}Th induced by 14.8-MeV neutrons. Various postulates of charge distribution were tested to correlate the experimental data. It was found that the equal-charge-displacement hypothesis agreed well for the fission products produced by the asymmetric mode of fission, and the constant-charge-ratio postulate showed the best correlation for the fission products produced by the symmetric mode of fission. Evidence for 40- and 50-proton shell effects on the fission yields was found. The charge distribution, which is different for asymmetric and symmetric regions of the mass yield curve, had been interpreted previously in terms of two separate modes of fission. The results of this investigation and the previous measurements of the independent yields both in asymmetric and symmetric regions of the mass-yield curve strongly favored the two-mode-fission-hypothesis. The cumulative isomer yield ratios σ_m/σ_g of the ^{115}Cd isomers were measured for the reactions ^{116}Cd (n,2n), ^{119}Sn (n,α), ^{232}Th (n,f) and ^{238}U (n,f) by 14.8 MeV neutrons. The ratios of the 43 day ^{115m}Cd ($11/2^-$) yield to the 2.3 day ^{115g}Cd ($1/2^+$) yield were 0.71 ± 0.06, 1.48 ± 0.20, 0.088 ± 0.015 and 0.12 ± 0.02 for the respective reactions. The isomeric cross section ratios of six isomeric pairs having spins and parities of the meta and ground states of $1/2^-$ and $9/2^+$ were measured for the ^{92}Mo (n,2n), ^{95}Mo (n,p), ^{97}Mo (n,p), ^{119}Sn (n,p), ^{92}Mo (n,α) and ^{180}Hf (n,α) reactions. The ratios were 0.09 ± 0.01, 0.06 ± 0.02, 0.24 ± 0.04, 0.08 ± 0.03, 0.13 ± 0.04 and 0.1 ± 0.05, respectively for the 14.8 MeV neutron-induced reactions. The experimental results were compared with the ratios calculated by Huizenga-Vanden-bosch method. The most probable excitation energies of the compound nuclei in the formation of ^{115}Cd isomers and also for the six isomeric pairs from various reactions were calculated. From the knowledge of the threshold energies for these reactions, it is suggested that there is a relation between cumulative isomer yield ratios and excitation energies above the threshold. (Diss. Abstr. Int., B)

9044 STATUS REPORT ON THE TRANSURANIUM ELEMENTS. Seaborg, G. T. (Univ. of California, Berkeley). (1973). vp.

From 24th IUPAC congress; Hamburg, Germany (2 Sep 1973).

The present status of the known transuranium elements is briefly reviewed, with emphasis on those most recently discovered. In the years following the completion of the actinide series with the discovery in 1961 of the eleventh transuranium element (lawrencium, element 103), the first two transactinide elements, elements 104 and 105, were discovered. There are competing claims by U. S. and Soviet scientists for the discovery of these two elements. The chemical properties and the position in the periodic table of these 13 known transuranium elements are discussed. Plans for the synthesis and identification of additional

near-transactinide elements and for the far-transactinide elements, the superheavy elements, are discussed. Predictions are made concerning the chemical properties, electronic structures and position in the periodic table of these elements. The possible synthesis of the transactinides, including the superheavy elements, by means of bombardments with heavy ions is described. This includes a discussion of the predicted nuclear properties of these elements and the nuclear reactions that might be used in their production. (12 figures, 6 tables) (auth)

9045 OPTIMUM Q-VALUE IN MULTINUCLEON TRANSFER REACTIONS. Wilczynski, J. (Univ. of Copenhagen). Phys. Lett.; 47B: No. 2, 124-128(29 Oct 1973).

The kinematics of multinucleon transfer reactions are examined under the assumption that the optimum Q-value is equal to the sum of the separation energies of the transferred nucleons. Very good agreement with experimental data is obtained. (auth)

9046 EXPERIMENTAL STUDY OF MASS ASYMMETRY IN SUBBARRIER PHOTOFISSION OF ^{238}U. Alm, A.; Kivikas, T. (Univ. of Lund, Sweden). Nucl. Phys., A215: No. 3, 461-470 (1973).

A measurement of symmetric and asymmetric photofission yields of ^{238}U in the energy region from 4.5 to 6.5 MeV was performed. As γ-source the bremsstrahlung from a microtron was used. The fission yields are obtained from β-counting of chemically separated isotopes ^{111}Ag, ^{115}Cd and ^{117}Cd for symmetric fission and ^{139}Ba for asymmetric fission. Some structures in the yield curves at about 5.3 MeV and a pronounced maximum at about 6.0 MeV in the valley-to-peak ratio in the fission fragment yield distribution are observed. It is suggested that these effects are connected with the double-hump fission barrier concept and indicate differences between fission barriers for symmetric and asymmetric fission. (auth)

9047 FUNDAMENTAL RESEARCH ON FISSION PROCESSES AT THE SACLAY NUCLEAR RESEARCH CENTER. Paya, D.; Signarbieux, C. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 179, 95-106(Mar 1973). (In French).

After a general survey of the progression of both the experimental knowledge and the theoretical ideas concerning fission processes, some recent experimental results obtained at C. E. N. Saclay on neutron-induced fission are presented. (FR)

9048 γ-RAY MULTIPLICITY IN ^{239}Pu FISSION INDUCED BY RESONANCE NEUTRONS: EXPERIMENTAL EVIDENCE FOR THE (n,γf) REACTION. Ryabov, Yu. (CEN de Saclay, Gif-sur-Yvette, France); Trochon, J.; Shackleton, D.; Frehaut, J. Nucl. Phys., A216: No. 2, 395-406(1973).

The fission γ-ray multiplicity measurement in the ^{239}Pu resonances was carried out, using the Saclay 60 MeV electron linac as a neutron source. Large fluctuations are observed from resonance to resonance, in correlation with the number ν of prompt neutrons, the total energy of these γ-rays and the fission width Γ_f. The results are interpreted in terms of a competition between the fission and the radiative capture during the de-excitation of the compound nucleus. They are the first experimental evidence of the (n,γf) reaction. Some parameters like the width $\Gamma_{\gamma f}$ are deduced. (auth)

9049 THEORY OF ISOMER RATIOS OF SHAPE ISOMERS IN HEAVY ION INDUCED REACTIONS. Sperber, D. (Rensselaer Polytechnic Inst., Troy, NY). Phys. Lett.; 47B: No. 3, 209-211 (12 Nov 1973).

A method for the calculation of excitation functions and isomer ratios, for shape isomers, in heavy ion induced reactions is proposed. The calculated values of excitation functions and isomer ratios agree very well with the experimental values for the reaction ^{238}U(^{11}B,α3n)^{242}Am. (auth)

9050 EMISSION OF HELIUM NUCLEI IN THE FRAGMENT DIRECTION IN FISSION OF ^{235}U INDUCED BY THERMAL NEUTRONS. Andreev, V. N.; Nedopekin, V. G.; Rogov, V. I. (Inst. of Theoretical and Experimental Physics, Moscow). Yadern. Fiz.; 18: No. 5, 976-979(Nov 1973). (In Russian).

Fission of ^{235}U induced by thermal neutrons with simultaneous emission of He nuclei under angles close to 0° related to the fission axis, was investigated. The energy spectrum of ^{4}He nuclei emitted in the direction of fragments is measured, as well as the fragment energy spectrum. The total yield of ^{4}He in the energy range 7–28 MeV was $(5.7 \pm 0.3) \cdot 10^{-3}$ $(N_\alpha^{tr}$ sterad$)^{-1}$, where N_α^{tr} is the α-particle yield from the triple fission in the same energy range. The upper bound for the ^{6}He yield in the energy range 9–33 MeV was found to be 10^{-4} $(N_\alpha^{tr}$ sterad$)^{-1}$. (auth)

9051 DECAY WIDTHS OF ONE-NUCLEON QUASISTATIONARY STATES OF DEFORMED NUCLEI. Kadmenskii, S. G.; Khlebostroev, V. G. (Voronezh State Univ., USSR). Yadern. Fiz.; 18: No. 5, 980-988(Nov 1973). (In Russian).

A formula is obtained that relates the nucleon scattering wave function for a nonspherical potential in resonance region to the quasistationary state wave function. Using this formula, an expression for the partial decay width of the quasistationary state is constructed, involving the overlapping integral of the decay channel wave function, the nuclear potential, and the quasistationary state wave function. The formula is generalized by account of nonspherical Coulomb potential. The partial and total decay widths are calculated for two proton and two neutron quasistationary states of the ^{239}U nucleus at $\beta_2 = 0.2$, $\beta_4 = 0.08$ and $\beta_2 = 0.23$, $\beta_4 = 0.08$. Effect of the diagonal and off-diagonal transitions is investigated, the obtained widths are compared with the corresponding widths for a spherical nucleus. A conclusion is presented that formulae of the R-matrix theory are ineffective for estimation of the widths of the considered states in deformed nuclei. (auth)

9052 RECOIL PROPERTIES OBTAINED FROM GAMMA-RAY SPECTRA OF GROSS FISSION PRODUCTS. Schroeder, B. (Univ. of Lund, Sweden). Nucl. Instrum. Methods; 112: No. 3, 603-606(1973).

The recoil properties in the 450 MeV proton-induced fission of uranium were studied using the direct γ-ray spectroscopy method. Good agreement with radiochemical data is obtained. (auth)

9053 AVERAGE YIELD OF INSTANTANEOUS NEUTRONS $\bar{\nu}$ DURING FISSION OF ^{233}U BY NEUTRONS WITH ENERGIES OF 0 TO 1.4 MeV. Nurpeisov, B.; Nesterov, V. G.; Prokhorova, L. I.; Smirenkin, G. N. At. Energ. (USSR); 34: No. 6, 491-492 (Jun 1973). (In Russian).

This method of determining average neutron yields is based on counting coincidences from a fission fragment detector (multilayered ionization chamber) and a neutron detector (He-3 counters in a paraffin block). The standard was the known neutron yield from ^{252}Cf, where the spontaneous neutron yield per fission $\nu_0 = 3.756$. The renormalized neutron yields for ^{233}U fission were found to be 2.511 ± 0.024 for 0.08 MeV neutrons, 2.489 ± 0.25 for 0.20 MeV neutrons, 2.464 ± 0.020 for 0.30 MeV neutrons, 2.484 ± 0.016 for 0.40 MeV neutrons, 2.494 ± 0.020 for 0.50 MeV neutrons, 2.514 ± 0.020 for 0.60 MeV neutrons, and 2.539 ± 0.022 for 0.70 MeV neutrons. (1 figure, 2 tables) (SJR)

9054 FISSION-FRAGMENT ANISOTROPY OF THE ^{238}U(n,2nf) THRESHOLD. Abegg, R.; Noelpp, U.; Wagner, R. (Univ., Basel). Helv. Phys. Acta; 46: No. 4, 445-451(1973). (In German).

The anisotropy of fragments was determined for fission of ^{238}U through neutrons in the energy range from 13 to 18 MeV. The anisotropy rose from 0.37 ± 0.06 at 13.7 MeV to 0.61 ± 0.07 at 14.8 MeV. The fragment angular distributions were measured with glass detectors. (tr-auth)

Nuclear Theory

Refer also to abstracts 8792, 8874, 9015, and 9033.

9055 (AE-479) SYSTEMATICS IN THE (p,xn) AND (p,pxn) REACTION CROSS SECTIONS. Jeki, L. (Aktiebolaget Atomenergi, Studsvik (Sweden)). 1973. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

A phenomenological formula depending on N, Z and A has been used earlier to calculate the cross sections of (n,2n), (p,2n) and (p,3n) reactions at constant excess energy. The validity of the formula is extended to (p,xn) reactions at 400 MeV proton energy and to (p,pxn) reactions at energies of several GeV. The formula gives good agreement between the calculated and measured cross sections. (auth)

9056 (COO-1569-106) LIQUID AND CRYSTALLINE NEUTRON MATTER. Nosanow, L. H.; Parish, L. J. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1972. Contract AT(11-1)-1569. 18p. (CONF-721207-2). Dep. NTIS $3.00.

From sixth Texas symposium on relativistic astrophysics; New York, New York, USA (18 Dec 1972).

Results of calculations of the ground-state energies of liquid and crystalline neutron matter are presented. It is found that neutron matter will crystallize at a density near normal nuclear density. This results indicates that a large fraction of the interior of a neutron star consists of crystalline neutron matter. An intuitive physical discussion is given to illuminate this result. Furthermore, it is suggested that, contrary to the usual point of view, low-den-

sity matter should be regarded as a "quantum liquid" which is "almost" a "quantum crystal". (2 figures, 1 table) (auth)

9057 (COO-3122-6) PRE-EQUILIBRIUM PROCESSES. Miller, J. M. (Columbia Univ., New York (USA)). Sep 1973. 43p. (CONF-730815-5). Dep. NTIS $4.25.

From international conference on nuclear physics; Munich, F. R. Germany (27 Aug 1973).

The treatment of nuclear reactions involving complex nuclei is usually handled by turning it essentially into a two-body problem solvable by quadrature (direct reaction theory) or treating the many bodies by quasi-equilibrium theory. A large body of data, however, appears to deviate from the predictions of both approaches. Some general remarks are made concerning the problem of "pre-compound decay", and then the Monte Carlo simulation, Boltzmann equation, and exciton model are described in moderate detail. The models are intercompared, and the present situation and prospects are sketched. (13 figures) (RWR)

9058 (HEDL-TME-73-79) NEUTRON CAPTURE CALCULATIONS FOR E_n = 100 keV to 4 MeV. Schmittroth, F. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1973. Contract AT(45-1)-2170. 68p. AT.

Radiative capture calculations based on the statistical model of the nucleus are studied for fast (a few MeV) neutrons. Both theoretical and phenomenological aspects are considered, with particular attention devoted to the description of low-lying inelastic target states. In addition to the usual energy-density description used for these states, formulas for the total neutron width are incorporated which utilize a statistical description of their spins and parities as well. To test and improve the calculations, the formalism is applied to a dozen nuclei specifically selected to evaluate the theory. Finally, as a means to judge the accuracy of the calculations, a brief statistical analysis is presented to supplement the more detailed comparisons between theory and experiment. (auth)

9059 (JEN-268) HADES: A COMPUTER CODE FOR THE CALCULATION OF NEUTRON CROSS SECTIONS BY MEANS OF THE OPTICAL MODEL. Guasp, J.; Navarro, C. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 90p. (In Spanish). Dep. NTIS (U. S. Sales Only) $6.50.

A FORTRAN V computer code for the UNIVAC 1108/6 which uses a local optical model with spin–orbit interaction is described. The code calculates fast-neutron cross sections, angular distributions and Legendre moments for heavy and intermediate spherical nuclei. It allows for the possibility of automatic variation of potential parameters for experimental data fitting. (1 figure, 1 table) (auth)

9060 (JINR-P2-7298) ROLE OF EXCHANGE EFFECTS IN THE REACTIONS OF QUASIELASTIC DEUTERON KNOCK-OUT. Markov, V. I.; Poch, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 12p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A guess for the ratio of the cross sections for scattering of protons on singlet and triplet quasi-deuterons is presented in pole and triangle diagram approximations. In both cases the ratio was found to be near unity. (2 figures, 2 tables) (auth)

9061 (JINR-P4-7314) ISOSPIN COLLECTIVE EXCITATIONS IN ATOMIC NUCLEI. Gabrakov, S. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A brief review of the Soviet and foreign papers concerning the study of the isospin collective excitations in atomic nuclei is given. Major attention is paid to formation of the isospin resonances in deformed nuclei. Results of numerical calculations of the energy and decay properties of these states are presented. (4 figures) (auth)

9062 (JINR-P4-7421) SEMIMICROSCOPIC DESCRIPTION OF DENSITY OF EXCITED STATES OF DEFORMED NUCLEI. Malov, L. A.; Solov'ev, V. G.; Voronov, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

A semimicroscopic method is presented for calculation of the density of the states of intermediate energy excitation and the highly excited states of deformed nuclei. With this method there were calculated the densities of states for 31 nuclei of the rare-earth and transuranium regions for the neutron coupling energy B_n. The results agree well with experiment. The difference in the density of even–even and odd-A nucleus states is correctly described. The influence of nuclear vibrations on the state density is studied. The dependence of the density of states on the excitation energy and on K quantum number values is also studied. (auth)

9063 (KFK-1840) $0^+ - 0^+$ SUPERALLOWED BETA TRANSITIONS AND THE WEAK VECTOR COUPLING CONSTANT. Behrens, H. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Experimentelle Kernphysik). Sep 1973. 55p. Dep. NTIS (U. S. Sales Only) $4.75.

In nuclear beta decay the weak vector coupling constant, G_β^V, can be determined only from $0^+ - 0^+$ superallowed beta transitions. Because of the great importance of G_β^V for all the theories of weak interactions, a big effort has been directed in recent years to the experimental and theoretical investigation of the ft values of these $0^+ - 0^+$ superallowed transitions. A compilation of the experimental results for the ft values and a discussion of the theoretical attempts to calculate the necessary corrections are given. Nevertheless, some existing discrepancies between experimentally measured ft values of different nuclei can not be explained. Finally, a value for $G_\beta^{(V)}$ is derived and compared with the weak vector coupling constants taken from other weak decay modes. This offers the possibility of discussing the concept of universality in weak interaction theory. (5 figures, 9 tables, 83 references) (auth)

9064 EFFECT OF THREE-BODY CLUSTER ON THE HEALING PROPERTIES OF THE JASTROW CORRELATION FUNCTION. Reinhard, P. G. (Erlangen-Nuernberg Univ., Erlangen, Ger.); Arenhoevel, H. Z. Phys.; 264: No. 3, 211-226(1973).

A variational equation for the Jastrow correlation function is derived from the energy functional expanded up to three-body cluster terms. The asymptotic behavior of this nonlinear equation is studied. The solutions show a healing at least of the type $\cos(\alpha r)/r^2$. The influence of higher cluster contributions is studied. Finally it is discussed how one can reduce the many-body cluster contributions to healing conditions to be used in the two-body cluster treatment. (GE)

9065 NUCLEAR EXCITATION BY ELECTRON TRANSITION AND ITS APPLICATION TO URANIUM-235 SEPARATION. Morita, M. (Osaka Univ., Toyonaka, Japan). Progr. Theor. Phys. (Kyoto); 49: No. 5, 1574-1586(May 1973).

A new mechanism for nuclear excitation is studied theoretically by considering the deexcitation of electronic states of atom. When an electron of inner shells is kicked off by the bombarded electron or X ray, an electron of the adjacent shells immediately jumps into the vacancy. The energy corresponding to the difference of the binding energies for these two shells, $E_1 - E_2$, is usually carried away by the emitted characteristic X ray or the Auger electron which is ionized from an outer shell. There is, however, another possibility of this energy release by exciting a nuclear state. That is, the nuclear ground state is excited to the higher energy level by receiving the excess energy of the electronic state by means of electromagnetic interactions between nucleus and electrons. A theory is made for this process, and it is found that the probability of this process is extremely small in most of the cases, but it will be appreciable if the interaction energy is approximately equal to the energy mismatch $E_N - (E_1 - E_2)$, where E_N is the nuclear excitation energy. An example of ^{235}U is discussed in connection with a possible separation of ^{235}U from uranium isotopes. (auth)

9066 EQUIVALENCE OF THE STRUTINSKY TYPE SMOOTHING AND THE TEMPERATURE AVERAGING METHOD. Bhaduri, R. K. (McMaster Univ., Hamilton, Ont.); Das Gupta, S. Phys. Lett.; 47B: No. 2, 129-132(29 Oct 1973).

The Fermi gas model of the nucleus at high temperatures can be used to define a ground state shell correction. It is demonstrated analytically that the shell correction so obtained is the same as that obtained from the Strutinsky type method. (auth)

9067 MASS PARAMETER OF THE BREATHING MODE STATE. Zamick, L. (Kernforschungsanlage, Juelich, Ger.). Phys. Lett.; 47B: No. 2, 119-120(29 Oct 1973).

A simple identity is used to show that when harmonic oscillator wave functions are used, the Inglis formula for the mass parameter of the breathing mode state yields the classical result. (auth)

9068 SPIN-TENSOR DECOMPOSITION OF NUCLEAR EFFECTIVE INTERACTIONS. Kirson, M. W. (Weizmann Inst. of Science, Rehovot, Israel). Phys. Lett.; 47B: No. 2, 110-114(29 Oct 1973).

A simple technique is described for extracting from two-body effective interaction matrix elements the separate contributions of the parts of the effective interaction of tensor rank zero, one and two in spin space. Some minor applications are presented to illustrate the method. (auth)

9069 ENERGY OF THE NUCLEAR MATTER IN THE PRESENCE OF THE π-CONDENSATE. Migdal, A. B. (Landau Inst. for Theoretical Physics, Chernogolovka, USSR). Phys. Lett.; 47B: No. 2, 96-98(29 Oct 1973).

The specific energy of the nuclear matter in the presence of the π^--condensate is found. The result differs essentially from

the corresponding expression obtained elsewhere. The change of the energy due to the π^--condensation is positive, i.e., in the region of the model applicability there are no phase transitions of both the first and the second order. (auth)

9070 ROTATIONAL-SINGLE PARTICLE STATES OF ODD-ODD NUCLEI HAVING A SMALL NONAXIALITY AND $j_p = j_n = 1/2$. Latipov, A. Sh.; Sharipov, Sh. (Tashkent State Univ.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 3, 103-104(1973). (In Russian).

In the theoretical study of the properties of odd-odd nuclei it is essential to separate the excitations into collective and single-particle excitations, and with odd-odd nuclei it is necessary to take into account the interaction of collective and single-particle excitations, and of the odd proton with the odd neutron. The system model consists of an ellipsoid of revolution and two external nucleons (the odd proton and the odd neutron). The momenta of the external nuclei is conserved, and surface oscillations of the nucleus are ignored. The energy of the rotational-single particle states is found to depend on two parameters λ and a, where a is the degree of nonaxiality and λ is an interaction constant which is assumed to be the same for the neutron and the proton. A theoretical level scheme is compared with the experimental level scheme for terbium-170. (SJR)

9071 DEATH TO PION CONDENSATES IN NUCLEAR MATTER. Barshay, S. (State Univ. of New York, Stony Brook); Brown, G. E. Phys. Lett.; 47B: No. 2, 107-109(29 Oct 1973).

It is first noted that if the coupling of spin-, isospin-modes in nuclei to pions were of anywhere near the strength required to produce pion condensation in nuclear matter, then there would be strong effects in nuclear spectra, which are not seen. A model proposed by Migdal is presented and it is shown that addition of a strong short-range repulsion in the nucleon-nuclear interaction modifies the effective interaction in such a way as to remove the main spin-isospin interaction which originally gave rise to the pion condensate. It is believed that short-range repulsions also strongly modify the work of Sawyer and Scalapino, but it is not yet shown that they destroy the condensate in neutron stars. The conclusion is that the off-shell p-wave attraction of pions and nucleons lies, at least in the region of low momenta, completely in the domain of the Δ-isobars. Effects from these would be incapable of producing pion condensates, except at high densities, equal to several times normal nuclear density. (auth)

9072 NUCLEAR FRICTION IN HEAVY ION SCATTERING. Beck, R. (Oxford Univ.); Gross, D. H. E. Phys. Lett.; 47B: No. 2, 143-146(29 Oct 1973).

The microscopic theory of nuclear friction in heavy ion scattering is developed. A relation of the friction tensor to the imaginary optical model potential is given, which seems to be very useful to get order of magnitude estimates of both quantities. (auth)

9073 THRESHOLD AND ANGULAR MOMENTUM LIMIT IN THE COMPLETE FUSION OF HEAVY IONS. Bass, R. (Univ., Frankfurt am Main). Phys. Lett.; 47B: No. 2, 139-142 (29 Oct 1973).

The interaction between two heavy nuclei is discussed within a simple, classical model, which allows quantitative predictions for interaction and fusion thresholds, and for limiting angular momenta in surface and fusion reactions. (auth)

9074 TWO-STEP PROCESSES VIA PARTICLE TRANSFER CHANNELS. Kunz, P. D.; Rost, E. (Univ. of Colorado, Boulder) Phys. Lett.; 47B: No. 2, 136-138(29 Oct 1973).

Two-step processes via particle transfer channels are formulated without employing the post-prior approximation. It is shown that this approximation leads to erroneous conclusions which seriously overestimate the effect of higher order processes. (auth)

9075 FISSION WIDTH OF EXCITED NUCLEI. Strutinskii, V. M. (Inst. for Nuclear Research, Kiev). Phys. Lett.; 47B: No. 2, 121-123(29 Oct 1973).

An interpolation formula for the fission width is obtained valid for small and large values of the viscosity parameter and assumptions concerning the shape of the potential energy barrier. Some inaccuracy in the commonly used statistical model expression for Γ_f is discussed. (auth)

9076 GAMOW-TELLER RESONANCE AND WIGNER MULTIPLET SCHEME. Gaponov, Yu. V.; Lyutostanskii, Yu. S. JETP Lett. (USSR) (Engl. Transl.); 18: No. 2, 75-77(20 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 2, 130-132(20 Jul 1973).

Quasiclassical solutions for the energies and matrix elements of the Gamow-Teller resonance are obtained within the framework of the theory of finite Fermi systems. It is shown that in medium and heavy nuclei this resonance is described in the Wigner supermultiplet scheme, and belongs together with the analog state to the supermultiplet $(T_0, 0, 0)$. (auth)

9077 KINEMATICS AND PHASE SPACE FOR TWO-PARTICLE CORRELATIONS IN THREE-, FOUR-, AND FIVE-PARTICLE FINAL-STATE REACTIONS. Van Oers, W. T. H. (Univ. of California, Los Angeles); Jain, M.; Bunker, S. N. Nucl. Instrum. Methods; 112: No. 3, 405-413(1973).

Kinematics and phase space are discussed for multiple-particle final-state reactions with up to five particles in the final state. It is assumed that the rest masses of all particles are known and that complete kinematic information is obtained for two of the outgoing particles. The effects of possible resonances for some particular situations are considered. (4 figures) (auth)

9078 SINGLE-PARTICLE STATES AND THE CONNECTION BETWEEN JASTROW AND BRUECKNER THEORY. Schaefer, L. (Univ., Heidelberg); Weidenmueller, H. A. Nucl. Phys., A215: No. 3, 493-514(1973).

Starting from Jastrow theory with the help of variational methods the first orders of the hole-line expansion are derived for the ground-state energy and for the associated wave function of a finite Fermi system. The implications of a variation of the energy expansion with respect to the single-particle basis are discussed both for Jastrow theory and for Brueckner theory. The mechanism which leads to the invariance of the complete hole-line expansion with respect to a change of the single-particle basis is elucidated. As a consequence, variation of the complete expansion in either theory gives a nontrivial result only if that result was built into the expansion from the outset. Nonetheless, variation of the lowest-order terms of the expansion leads to definite results and yields the necessary conditions for natural orbitals. (auth)

9079 SOLUTION OF THE HARTREE-FOCK-BOGOLIUBOV EQUATIONS AT HIGH ANGULAR FREQUENCY. Bhargava, P. C.; Thouless, D. J. (Univ. of Birmingham, Eng.). Nucl. Phys., A215: No. 3, 515-524(1973).

Solutions to some of the difficulties which arise when Hartree-Fock-Bogoliubov equations are solved at high angular frequency are considered. These are mainly associated with the fact that then instead of particles always decoupling in pairs, may do so singly and hence lead to quasi-particle wave functions containing an odd number of particle components in the quasiparticle wave function. These solutions then also lead to a satisfactory, reliable and fast method for connecting the upper and lower branches of the moment of inertia versus square of the angular frequency curve, and usually reproduce the typical S-shape of the curve. Also the importance of higher (> 0) particle-particle channel coupled angular momentum of the nucleon-nucleon potential for the rotational spectrum of deformed nuclei at high angular momentum is shown. Some unsolved problems and peculiar cases which arise during the solution of Hartree-Fock-Bogoliubov equations are mentioned in the end, which may be a reflection on the unsatisfactory nature of the present method of obtaining higher angular momentum rotational bands. (auth)

9080 REMARKS CONCERNING THE NUCLEAR SURFACE AND CURVATURE ENERGY. Stocker, W. (Univ., Munich). Nucl. Phys., A215: No. 3, 591-597(1973).

The $A^{\frac{1}{3}}$ term in the nuclear mass formula is studied. The curvature correction is investigated within the framework of the energy density formalism; the compression term is evaluated from a phenomenological point of view. The results are in fair agreement with the droplet model values obtained by Myers and Swiatecki. (auth)

9081 CALCULATIONS OF THE CRITICAL ANGULAR MOMENTUM IN THE ENTRANCE REACTION CHANNEL. Wilczynski, J. (Univ. of Copenhagen). Nucl. Phys., A216: No. 2, 386-394 (1973).

A dynamic model, based on the force equilibrium concept, is proposed to estimate the critical angular momentum in the entrance channel for reactions between complex nuclei. The nucleus-nucleus force is derived from simple surface-energy considerations. Good agreement with the experimental data on complete-fusion cross sections is obtained. (auth)

9082 DENSITY OF LEVELS IN LIGHT EVEN-EVEN NUCLEI FOR AN EXTENDED RANGE OF EXCITATION ENERGIES. Ignatyuk, A. V.; Sokolov, Yu. V.; Shubin, Yu. N. Yadern. Fiz.; 18: No. 5, 989-998(Nov 1973). (In Russian).

Description of the available complex of experimental data on density of levels in light nuclei based on the superfluid nuclear model is considered. It is shown that the shell structure influences essentially the energy dependence of the level density at low excitation energies. (auth)

9083 ANHARMONIC EFFECTS IN LOW-LYING EXCITATIONS OF SPHERICAL NUCLEI. Stepanov, B. E. (Novosibirsk State Univ., USSR). Yadern. Fiz.; 18: No. 5, 999-1010(Nov 1973). (In Russian).

The effects in Belyaev's and Zelevinsky's model of anharmonical quadrupole oscillations are considered. The results are compared with the data. It is shown that the model describes satisfactorily a great number of nuclei having no equilibrium deformation. (auth)

9084 ACCOUNT OF ANHARMONIC TERMS IN THE KINETIC ENERGY FOR COMPLEX AND SIMPLE COLLECTIVE MODELS. Fedorov, A. D. (Kharkov Polytechnic Inst.). Yadern. Fiz.; 18: No. 5, 1011-1016(Nov 1973). (In Russian).

Many qualitative results of the calculations by Kumar and Baranger due to the anharmonic terms in the kinetic energy may be obtained using a more simple model of rigid asymmetric rotator taking into account a term $\sim\beta^3$ in the kinetic energy that results in the corresponding anharmonic effects in the inertial functions. (auth)

9085 ESTIMATION OF THE MULTIDIMENSIONAL HARMONICS METHOD BY MEANS OF GREEN'S FUNCTIONS. Gorbatov, A. M. (Kalinin State Univ., USSR). Yadern. Fiz.; 18: No. 5, 1017-1027(Nov 1973). (In Russian).

The Lippman–Schwinger integral equation for a system of A bound nucleons is considered. An attempt is made to solve it by iterations. The ground state function Ψ_0 and energy E_0 of the multidimensional harmonics method are used as the zero approximation. The first iteration Ψ_1 and the corresponding energy E_1 are studied in detail. It is shown that for realistic potentials the value of $|E_1|$ is several times as much as $|E_0|$ ($E_1 < E_0$). There are all the potential harmonics in the expansion of Ψ_1 over the hyperspherical functions. (auth)

9086 EXPLANATION FOR FORKING AND BACKBENDING IN ROTATIONAL SPECTRA. Smith, B. C.; Volkov, A. B. (McMaster Univ., Hamilton, Ont.). Phys. Lett.; 47B: No. 3, 193-196 (12 Nov 1973).

It is shown that symmetric deformed nuclei are unstable to asymmetric deformation at sufficiently high angular momentum. Forking and backbending are natural consequences of this instability. (auth)

9087 RENORMALIZED VARIATIONAL THEORY: ITS STRUCTURE, INTERPRETATION, AND RELATION TO OTHER METHODS. Schaefer, L. (Univ., Heidelberg). Nucl. Phys.; A216: No. 2, 365-385(1973).

The Ritz variational principle is applied to a renormalized form of the Iwamoto-Yamada cluster expansion, restricting the discussion to infinite systems. The structure of the resulting theory is governed by the renormalization which keeps track of the normalization denominator in the expectation value. The single-particle potential for hole states (u_l) is introduced as a Lagrange multiplier in the variational principle, and the self-consistent choice of u_l guarantees that the renormalization factors are determined correctly. The importance of the renormalization is illustrated by a discussion of the two-body approximation to our theory. The general formalism is evaluated in more detail for the representation $\Psi_T = \exp(S)\Phi$ of the trial wave function. Very fundamental considerations show that the theory is especially adapted to that choice of Ψ_T. In addition, if that choice of Ψ_T is used, the self-consistent single-particle energies are directly related to experiment, and the theory is almost identical to renormalized Brueckner theory. Thus many aspects of the latter can be clarified. The relation to the theory of Coester and Kümmel is also discussed. (auth)

9088 STRUCTURE OF THE DEFORMED TERMS OF THE ROTATIONAL-MODEL OPTICAL POTENTIAL. II. Sevgen, A. (Univ., Freiburg i. B.). Nucl. Phys.; A216: No. 3, 429-456 (1973).

The microscopic optical matrix potential (OMP^m) for rotational nuclei is constructed. The structure of the nondiagonal elements of OMP^m is investigated and compared with the deformed part of the phenomenological optical potential (OMP^p) employed in analyses of nucleon inelastic scattering data. The deformed form of OMP^p relates the real parts of the phenomenological form factors. This relation is shown to be approximately satisfied by the microscopic form factors. It is proved that the decay amplitudes of complicated compound states to similar channels are correlated, an effect called the similar channels effect (SCE). Some channels are similar since the rotational states of the target are obtained from the same intrinsic state. The commonly used deformed imaginary part of OMP^p at very low energies (few MeV or less) may be justified as being due to the similar channels effect. (7 figures) (auth)

9089 EIKONAL APPROACH TO DISPERSION CORRECTIONS IN ELASTIC ELECTRON SCATTERING. Rosenfelder, R. (Univ., Freiburg i. B.). Nucl. Phys.; A216: No. 3, 477-492(1973).

Dispersion corrections to elastic electron scattering are calculated using an eikonal approximation for the electron. Additional phase shifts, $\Lambda(b)$, with $b = j + \frac{1}{2}/k$ can be defined which have to be added to the static phase shifts, χ_j, obtained from a partial-wave calculation. Equivalent is a description by an energy-independent optical potential. Summation over the excited nuclear states is done by a special closure approximation. The only free parameter — the mean excitation energy — can be determined by the photo sum rule σ_{-2}. Total inelastic cross sections agree well with experimental estimates; corrections in the elastic cross section are usually negative and small except in diffraction minima. (auth)

9090 NUCLEON CHANNEL COUPLING IN ELECTRODISINTEGRATION OF NUCLEI. Balashov, V. V.; Grishanova, S. I.; Kabachnik, N. M.; Kulikov, V. M.; Titarenko, N. N. (Moscow State Univ.). Nucl. Phys.; A216: No. 3, 574-588(1973).

The process of nuclear excitation above threshold for nucleon decay in high-energy electron scattering is considered. On the basis of the particle–hole shell model a formalism is proposed which allows one to describe electroexcitation of nuclei in a unified manner both in the resonance and quasi-elastic scattering regions. Numerical calculations were made for the ^{12}C nucleus, taking into account the mixing of proton and neutron configurations (channels) of the particle–hole type in the continuum. (auth)

9091 APPLICATION OF CONTINUED FRACTIONS TO BOUND-STATE PROBLEMS. Lavine, J. P.; Picker, H. S. (Univ., Liege). J. Phys., A (London); 6: No. 10, L137-L139 (Oct 1973).

It is pointed out that the eigenvalue condition used by Biswas and Vidhani (J. Phys. A. Math. Nucl. Gen.; 6: 468-77 (1973)) gives incorrect results for bound-state energies in two of the examples with which they illustrate their method. The error in the first of these applications is traced to the fact that their representations of bound-state radial functions do not necessarily vanish at the origin. In the second example in question, the bound states are not properly distinguished from the antibound states. In both cases, the defective results arise from neglect of boundary conditions. (auth)

9092 APPLICATION OF REGULATION TO THE PROBLEM OF TRANSVERSE CROSS SECTIONS OF PHOTONUCLEAR REACTIONS. Ivanchenko, V. G. Tr. Fiz. Inst., Akad. Nauk SSSR; 63: 151-157(1972). (In Russian).

The problem of photonuclear reaction cross sections and methods of solution are discussed. On the basis of a mathematical-statistical treatment of a smoothing functional as the negative logarithm of a function of verisimilitude and of a regulating functional as a correlation matrix of a method of minimum function of verisimilitude, there is proposed an approximate solution to Fredholm's equation of the first order, in which the result is weakly dependent on the statistical errors of the original data. (tr-auth)

9093 PHYSICALLY BASED PARAMETRIZABILITY OF THE SPECTRA AND CROSS SECTIONS IN FAST NEUTRON INELASTIC INTERACTION WITH ATOMIC NUCLEI. Hermsdorf, D.; Richter, H. P.; Sassanoff, S.; Seeliger, D.; Seidel, K. (Technische Univ., Dresden). Kernenergie; 16: 252-257(Aug 1973). (In German).

A method for parametrization of both spectra and cross sections of inelastic interaction of fast neutrons with nuclei analogously done by the optical model for elastic scattering of nucleons is presented. Starting from analysis of the spectra of inelastic interaction of 14-MeV neutrons in a combined model of emission from equilibrium and non-equilibrium states an excellent description of spectra can be verified by only three parameters. The properties of the proposed parametrization are investigated with these spectra. It seems to be very suitable for storage, extrapolation, and evaluation of inelastic cross sections of fast neutrons. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

9094 PLASMA PHYSICS INDEX. Volume 8, No. 10, 1973. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 219p.

9095 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 7, No. 10, 1973. Bibliography, Author Index, Subject Index, and Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 47p.

9096 PHENOMENA IN IONIZED GASES 1971. Contributed Papers. Tenth International Conference, Oxford, England, September 13–18, 1971. Franklin, R. N. (ed.). Oxford; Donald Parsons and Co. Ltd. (1971). 485p. (CONF-710920-P1).

From 10th international conference on phenomena in ionized gases; Oxford, UK (13 Sep 1971).

The texts of the 440 contributed papers are presented and are classified under five categories that include Collision Processes in Gases; Surface Phenomena; Electrical Discharges; Plasma Physics; and Experimental Techniques. See also NSA 26: 32468. (MCW)

9097 PHENOMENA IN IONIZED GASES 1971. Invited Papers. Tenth International Conference, Oxford, England, September 13–18, 1971. Davenport, P. A. (ed.). Oxford; Donald Parsons and Co. Ltd. (1971). 466p. (CONF-710920-P2).

From tenth international conference on phenomena in ionized gases; Oxford, UK (13 Sep 1971).

The texts of the 14 invited papers are presented. The subjects encompass a wide field and include chemistry, combustion, and clustering in ionized gases. Separate abstracts were prepared for each and appeared in NSA Volume 26, Number 13, July 15, 1972. See NSA 26: 32468. (MCW)

Confinement and Heating

Refer also to abstracts 9176, 9200, and 9224.

9098 (EUR-CEA-FC-700) WAVE-PLASMA INTERACTION NEAR THE LOWER HYBRID FREQUENCY. Pesic, S. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 - (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jul 1973. 216p. (In French). Dep. NTIS (U. S. Sales Only) $13.00.

A theoretical and experimental study of wave–plasma interaction near the lower hybrid frequency is presented. The propagation properties of the resonant electromagnetic mode, the waves in an inhomogeneous cold plasma column, the wave coupling near the lower hybrid resonance, the damping of plasma waves, the efficiency of the lower hybrid heating, and the coupling with an external hf source were investigated. The lower hybrid resonance phenomenon was demonstrated in the Chimere experiment. The results obtained indicate that the lower hybrid plasma heating is a fast and efficient process. Its application in a plasma close to thermonuclear conditions seems very interesting. (FR)

9099 (KHFTI-72-1) CONCERNING HIGH-FREQUENCY HEATING OF A HETEROGENEOUS PLASMA. I. Longinov, A. V.; Stepanov, K. N. (AN Ukrainskoj SSR, Kharkov. Fiziko Tekhnicheskij Inst.). 1972. 31p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

The possibility of heating a heterogeneous plasma of large volume with small-amplitude electromagnetic waves in the linear regime was investigated. The excitation and propagation of low-frequency electromagnetic waves in the heterogeneous plasma were examined. Heating with fast magnetosonic waves under conditions of lower hybrid resonance was investigated. (tr-auth)

9100 (KHFTI-72-2) CONCERNING HIGH-FREQUENCY HEATING OF A HETEROGENEOUS PLASMA. II. Longinov, A. V.; Stepanov, K. N. (AN Ukrainskoj SSR, Kharkov. Fiziko Tekhnicheskij Inst.). 1972. 36p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

The heating of large-volume plasmas with electromagnetic waves with a frequency $\omega \lesssim \omega_B$ was investigated. The heating of plasma with fast magnetosonic waves with frequencies $\omega \approx \omega_B$ and $\omega \approx 2\omega_B$, with ion cyclotron waves, with magnetohydrodynamic waves ($\omega \ll \omega_B$), and by means of magnetic pumping was also examined. (tr-auth)

9101 (LA-5444-MS) SYMMETRY OF LASER-DRIVEN IMPLOSIONS. Henderson, D. B.; Morse, R. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 5p. Dep. NTIS $4.00.

The achievement of significant nuclear energy yields from laser-heated pellets of thermonuclear fuel requires that the fuel be compressed to at least several orders of magnitude above initial density. Such compressions can be attained by spherical implosions, but because of the large compression ratios required, these implosions must be highly symmetrical. Calculations of the behavior of imploding spheres and shells by a spherical harmonic perturbation method, and by two-dimensional hydrodynamic codes within their limitations, have shown the importance of electron thermal conduction in the low-density ablation cloud of a pellet in bringing about the required symmetry. These calculations show that, at early time in the heating of a pellet when the ablation cloud is relatively small and cold, the symmetry requirements are most severe and call for as many as four laser beams. However, symmetry requirements at later times, when most of the laser energy must be deposited, may be met by as few as one beam. (auth)

9102 (RLO-2225-T-28-1) INTERACTION OF MAGNETICALLY CONFINED PLASMAS WITH INTENSE RADIATION FROM AN ELECTRON BEAM STABILIZED CO_2 LASER. Annual Report. Vlases, G. C. (Washington Univ., Seattle (USA). Aerospace Research Lab.). 1973. 27p. Dep. NTIS $3.50.

The development program for the CO_2 laser is described. The electron source, vacuum system, and optical cavities along with some preliminary data are described. Two experiments were proposed. One of them involves irradiating a plasma in a quasi-steady solenoided field, while the other consists of irradiating a pinch plasma under conditions that anomalous backscatter should occur. The progress of these programs is described. (MOW)

9103 (TRITA-EPP-72-33) HIGH-BETA PLASMAS CONFINED IN POLOIDAL MAGNETIC FIELDS. Lehnert, B.; Hellsten, T.; Raggi, R. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). 22 Dec 1972. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

Experiments on rotating plasmas provide methods for studying the important problems of plasma equilibrium and stability at high-beta values. This report describes investigations on high-density plasmas being performed by means of probe and Rogowski coil recordings: (i) Appreciable forces can be generated in the plasma, corresponding to equivalent beta values as high as about 20%. The magnetic field lines are in some cases "pushed out" radially by a considerable fraction of the distance from the axis of symmetry. (ii) The observed plasma behavior agrees roughly with that predicted by a simple classical model. (iii) The plasma is at least macroscopically stable with respect to flute and ballooning modes and has an outer boundary being sharply defined by the conditions imposed by a limiter and a surrounding neutral gas blanket. (auth)

9104 INVESTIGATION OF PLASMA CONFINEMENT l = 1 TORSATRON VINT-20. Georgievskii, A. V.; Letuchii, A. N.; Manzyuk, N. A.; Pogozhev, D. P.; Pyatov, V. N.; Reva, N. I.; Solodovchenko, S. I.; Suprunenko, V. A.; Sukhomlin, E. A.; Tolok, V. T. (Physical-Technical Inst., Kharkov). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The toroidal l = 1 torsatron "Vint-20" with a spatial magnetic axis, as distinguished from the stellarator classical scheme, has only one helical winding with a modulated winding angle, this winding producing both longitudinal and helicoidal magnetic fields. Investigations of magnetic field structure by means of the electron-beam method showed the working volume to be limited by the helical corrugated magnetic surface with the spatial magnetic axis. Preliminary experiments on plasma confinement in "Vint-20" were made at quasi-stationary magnetic field strengths up to approximately 2 kOe. Plasma was produced by a titanium injector placed close to the last magnetic surface. For measuring plasma parameters and confinement time, moving electric probes and multimode resonator methods were used. These measurements showed that the maximum density of trapped plasma was approximately 1×10^{10} cm^{-3}, and its boundary agreed with dimensions of the last closed magnetic surface. (GE)

9105 NEUTRAL INJECTION HEATING INTO THE FONTENAY-AUX-ROSES TOKAMAK (TFR). Dei-Cas, R.; de Sacy, S.; Druaux, J.; Marty, D. A.; Rebut, P. H. (Cen, Fontenay-aux-Roses, France). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The goal of this heating experiment now under construction is to change significantly the ion and electron temperatures, i.e., to reach the keV range and to explore the "banana" regime. The calculations show that a power of a few hundred kilowatts (≈300 kW) must be injected into the plasma for 200 ms. This will be achieved

by two sets of five neutral-beam injectors of the Oak Ridge type, injecting along two lines close to the perpendicular and diametrically opposite. (GE)

9106 THEORY OF NEUTRAL BEAM INJECTION INTO A TOKAMAK. Callen, J. D.; Clarke, J. F.; Rome, J. A. (Oak Ridge National Lab., TN). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Plasma perturbations caused by injection of a neutral beam into a tokamak plasma are examined to determine if there are any limitations to this method of heating and replenishing the plasma. In the ORMAK device, tangential neutral beam injection with $I_0\tau \sim 0.03$ and $I_0 t \sim 0.3$ (a single beam) is expected to be sufficient to cause significant plasma heating, and in particular ion heating. The estimates indicate that at this beam strength the plasma perturbations are small, except for the buildup of radial electric fields greater than those in quasi-equilibrium tokamaks without injection, the net effect of which is unclear. Perpendicular injection, while having some advantages, appears to cause more serious poloidal electric fields and hence radial plasma flow or convection. (GE)

9107 NEUTRAL BEAM INJECTION HEATING OF ORMAK. Stewart, L. D.; Davis, R. C.; Hogan, J. T.; Jernigan, R. C.; Morgan, O. B.; Stirling, W. L. (Oak Ridge National Lab., TN). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

A basic ORMAK neutral-injection heating module was developed that is capable of delivering 120 kW to the plasma with acceptable levels of impurities and streaming neutral gas. Independent variation of the energy, power, equivalent current, neutral species, time of injection, and angle of injection will be possible. Significant increases in ion temperatures are expected when using these heaters. Each injector can supply atomic neutrals at three different energies so that 12 simultaneous energies can be supplied with four injectors. The displacement of the toroidal field coils to allow for the beam tube causes a field perturbation of about 1% at the liner and about 0.4% at the discharge center. Kilovolt ion temperature increases are expected from this heating. (GE)

9108 HIGH-FREQUENCY HEATING IN PROTO-CLEO. Millar, W.; Bolton, R. A. E.; Cattanei, G. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Experiments are described using the l = helical winding in PROTO-CLEO. The introduction of a Faraday cage produces a substantial increase in the rate of rf-induced pumpout. Plasma density is measured with a 20-GHz microwave interferometer, and ion energy with a multi-gridded analyzer. Some of the experiments were repeated with the cage in position, using hydrogen in the gun and a pumping frequency of 125 kHz. The coils were connected in anti-phase so as to give a standing wave. (GE)

9109 LASER PLASMA CONTAINMENT IN THE TOR-1 STELLARATOR. Andrukhina, E. D.; Voronov, G. S.; Smirnova, A. D.; Kholnov, Yu. V.; Fedyanin, O. I.; Shpigel, I. S. (Inst. of Physics, Moscow). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The collisional plasma containment time was studied as a function of plasma parameters in the wide range of collision frequency. Experimental dependences are shown not to coincide with the conclusions of the neoclassical theory. Particle-containment time was investigated as a function of the parameters which, according to the theory, are responsible for the diffusion. Plasma was produced by laser injection. This method allowed the change of plasma parameters in the following ranges: n(e) from 5×10^{10} to 10^{12} cm^{-3}, T(e) from 0.3 to 3 eV, T(i) from 5 to 60 eV. Plasma consisted mainly of singly ionized lithium, the neutral lithium density amounting to 10^{-3} of plasma density. The containing magnetic field was changed from 4 to 12 kG. (GE)

9110 BEAM HEATING IN A PLASMA FOCUS. Gribkov, V. A.; Krokhin, O. N.; Sklizkov, G. V.; Filippov, N. V.; Filippova, T. I. (Lebedev Inst. of Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 1, 5-7(5 Jul 1973).

Translation of Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 1, 11-15(5 Jul 1973).

High-speed interferometry methods are used to show that powerful electron beams, subjected to hose instability and focusing in the plasma, are produced during the concluding stage in a plasma focus. The anomalous scattering of the diagnostics laser radiation and the powerful x radiation of the plasma from the beam-focusing region point to the development of two-stream instability and strong heating of the plasma in this region. This explains the principal neutron pulse produced in the setup. (auth)

9111 PLASMA HEATING BY NEUTRAL PARTICLE BEAMS. Junker, J. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1973). vp. (In German).

From spring meeting of the Deutsche Physikalische Gesellschaft: pulse physics, plasma physics, and gas discharges, quantum optics; Berlin, Germany (9 Apr 1973).

The heating of a plasma by means of neutral particle beams seems feasible, fairly simple, and very effective. The development of the necessary particle sources for the present-generation experiments can be taken as concluded. The processes in the absorption and thermalization are discussed in detail. Future experiments, especially with regard to a fusion reactor, still require an intensive and far-reaching development in the field of the sources. The preliminary experimental investigations have confirmed possible heating of plasma to fusion temperatures by means of neutral-particle beams. (GE)

9112 CONFINEMENT OF A LOW COLLISION FREQUENCY PLASMA IN THE SATURN-1 TORSATRON. Voitsenya, V. S.; Voloshko, A. Yu.; Solodovchenko, S. I.; Suprunenko, V. A.; Tolok, V. T. (Physical-Technical Inst., Kharkov). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The lack of a theory of diffusion in stellarators explains the interest in experimental studies of a low-collision-frequency plasma confinement. Such experiments offer the possibility to model and to investigate some peculiarities of a high-temperature plasma confinement. The titanium plasma source was used for the experiments on the toroidal l = 3 "Saturn-1" torsatron. Plasma density measurements were made using a single Langmuir probe and a multimode resonator method. The plasma confinement time was measured 5 msec after injection at electron density equal to 5×10^8 cm^{-3}. Electron and ion temperature, measured with a single and multigrid probe, were ≈8 and 20 eV, respectively. The results show a continuation of a "plateau coefficient" diffusion to the banana region. This is in qualitative agreement with measured values of the radial electric field. (GE)

9113 SELF-CONSISTENT ELECTROSTATIC FIELD INDUCED BY TTMP. Canobbio, E.; Nakach, R. (CEN, Grenoble, France). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The self-consistent electrostatic field component which insures plasma charge neutrality in Transit Time Magnetic Pumping in the small-collision-frequency limit is calculated for arbitrary temperatures and phase velocities. The usual collisionless linear theory of TTMP is valid when the Coulomb collision frequency is smaller than the pumping frequency. (GE)

9114 LOSSES INDUCED BY ELECTRIC FIELDS WITH TRANSIT TIME MAGNETIC PUMPING IN TORIODAL GEOMETRY. Brambilla, M. (CEN, Grenoble, France). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

A mechanism of ion diffusion analogous to the neoclassical diffusion is shown to be active when Transit Time Magnetic Pumping (TTMP) is applied to a plasma column confined by a magnetic field having a finite rotational transform. The resulting enhancement of plasma losses can be kept negligible by providing appropriate boundary conditions (electrostatic screening) to the electric field. A quantitative derivation of the diffusion in the linear regime is presented. (GE)

9115 CONFINEMENT OF PARTICLES AND ENERGY IN TOKAMAK PLASMAS. Hinnov, E.; Dimock, D.; Johnson, L. C.; Meservey, E. (Princeton Univ., NJ). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Improvements in the Ohmic heating power supply and in the coils providing the vertical field have permitted increasing the current in the ST Tokamak to about 120 kA for 40 to 50 msec. The discharge characteristics, particle confinement time, average electron temperature, total electron energy and ion temperature were determined by laser scattering or charge-exchanged H energy distribution. The electron density and temperature profile were determined by laser scattering at 20 and 40 msec. (GE)

9116 AXISYMMETRIC TOROIDAL CONFINEMENT EXPERIMENT WITH NONCIRCULAR CROSS-SECTION (TENQ). Dippel, K. H.; Janicke, L.; Kaleck, A.; Kever, H.; Schlueter, J. (Kernforschungsanlage, Juelich, Ger.). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The possibilities of obtaining higher β values in axisymmetric toroidal confinement systems with $q > 1$ are discussed. The design of a larger experiment with noncircular cross section is described. The aim of this experiment is to show that elongated

cross sections allow higher β and j_ϕ and that the conditions for heating by fast magnetic compression are improved. (GE)

9117 TURBULENT HEATING OF IONS AND ANOMALOUS SKIN EFFECTS IN A TOROIDAL DEVICE. Hirose, A.; Lee, A.; Skarsgard, H. M. (Univ. of Saskatchewan, Saskatoon). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The ion-heating mechanism and behavior of plasma current penetration were investigated in a toroidal turbulent heating device. Rapid ion heating observed was attributed to ion acoustic turbulence. Observed rapid and deep-current penetration cannot be explained by the plasma resistivity. Experiments were performed in a toroidal device. A betatron-type electric field of about 100 V/cm is applied parallel to a toroidal magnetic field about 2 kG after the formation of the initial argon or helium plasma with a density 10^{11} to 7×10^{13} cm^{-3}. It was found that the electrons are rapidly heated (several keV within 0.5 μsec) by the "trapped-particle" instability, which is caused by an initial ion density perturbation. Time-resolved argon-ion temperature measurements show that the ions start being heated at about 1 μsec after application of the electric field. Spatial and temporal behavior of the plasma current was studied by a small magnetic probe for a wide range of plasma density (10^{11} to 7×10^{13} cm^{-3}). (GE)

9118 EXPERIMENTS ON THE OHMICALLY HEATED PLASMA IN THE HELIOTRON D. Uo, K.; Iiyoshi, A.; Morimoto, S.; Sasaki, A.; Yoshioka, S.; Ohtake, I.; Konoshima, S.; Sato, M.; Koyama, M.; Obiki, T. (Kyoto Univ., Uji, Japan). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Effects of rotational transform and shear on the ohmic current in the Heliotron D are described. For the small t(0) and shear of the confining field, violent current oscillations are observed in helium when the rotational transform near the plasma boundary is ½, 1, but in the case of the very strong t(0) and shear no significant instability is observed and the rotational transform t(0H) produced by the current is as large as 2.5. The confinement and rf-heating experiment are also briefly presented. Experimental diffusion constants are given, taking into account the measured density distributions. Coulomb collisions are predominant for the afterglow plasma in the MHD region, in contrast to the case of the gun plasma in which electron–neutral collisions are dominant. The input power is measured by a directional coupler for ion cyclotron waves as a function of the plasma density. The maximum input power of 30 kW is roughly ten times larger than the previously reported value. (GE)

9119 COLD NEUTRALS AND CHARGE EXCHANGE IN TOROIDAL PLASMAS. Podesta, G.; Engelmann, F. (CNEN, Frascati, Italy). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Using a simple stationary model, the importance of charge-exchange losses is discussed for both permeable and impermeable plasmas. The relation between these losses (and, consequently, the neutral density in the plasma) and the charged-particle confinement is displayed. In the regime of volume losses, it is expected that the neutral population in the plasma interior is dominated by particles having a certain energy such that their mean free path is somewhat smaller. In the diffusive regime, the average energy of neutrals and ions is equal. Hence, one has to consider only "hot" neutrals. (GE)

9120 PLASMA HEATING AND CONFINEMENT IN THE LIVERMORE SUPERCONDUCTING LEVITRON. Hartmann, C. W.; Anderson, O. A.; Birdsall, D. H.; Hooper, E. B. Jr.; Munger, R. H. (Univ. of California, Livermore). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Stable confinement of approximately isotropic hot-electron plasma is observed for $\beta \leq 0.1$ and $\beta(\Phi) = \beta B^2/[B(\Phi)]^2 \leq 10$. Confinement at large $\beta(\Phi)$ without anomalous loss is found to result from a cold-plasma background with $n(ec)/n(eh) \simeq 10$ to 10^2. Heating of dense plasma ($n(ed) \simeq 10^{11}$ to 5×10^{12}, $T(ed) \simeq 10$ to 20 eV) occurs by thermalization with the hot-electron plasma at a collision-determined rate without significant anomalous loss of hot electrons. Diagnostics consist of x-ray measurements, cold plasma temperature measurements using a Langmuir probe at the plasma boundary, a plunging-probe calorimeter, and measurements of the Φ-directed diamagnetic current by a Rogowski coil. (GE)

9121 MICROWAVE ABSORPTION IN UPPER HYBRID FREQUENCY RANGE IN TOKAMAK FT-1. Golant, V. E.; Larionov, M. M.; Levin, L. S.; Pakhomov, L. P.; Podushnikova, K. A.; Rozhdestvenskii, V. V.; Serebreny, G. A. (Physical-Technical Inst., Leningrad). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Results on microwave absorption by plasma in Tokamak FT-I at upper hybrid resonance frequency are described. The dependence of the absorption on magnetic field strength and plasma density is determined. The toroidal discharge chamber of the installation has a 62-cm major radius and a 17-cm limiter radius. The magnetic field at the chamber axis reaches 9 kG. The microwave generator, operating in the 200-μsec pulse regime, was coupled to the discharge chamber through a horn antenna placed at the weak magnetic field side of the torus. The power used was 50 kW at 30 Gc and 12 kW at 22 Gc. For plasma light emission observation in the visible region, a photoamplifier with a broad field of vision was used. Electron density was measured by a 4-mm interferometer. Electron temperature was estimated from plasma-conductivity measurements. The experiments were carried out in a hydrogen discharge at an initial pressure of 0.15 to 0.2 mtorr and discharge currents from 1 to 5 kA. (GE)

9122 HEATING BY HELICAL ALFVEN WAVES. Grossmann, W.; Kaufmann, M.; Neuhauser, J. (Max-Planck-Institut fuer Plasmaphysik, Garching). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Recent considerations are presented concerning the use of helical Alfven waves for heating high-density, high-β plasmas. The considerations are not limited to either high-β or highly compressed plasmas. A practical barrier can be derived by considering the validity of MHD equations, about which the wave damping theory has been developed. (GE)

9123 NEUTRAL-INJECTION-INDUCED ROTATIONS IN TOROIDAL PLASMAS. Canobbio, E.; de Barbieri, O. (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The buildup and decay rates of the rotations produced in an axisymmetric torus by neutral-atom beams are calculated. The rotation velocities of present-generation devices and of a fusion reactor are discussed. (GE)

9124 H-f PLASMA HEATING IN THE URAGAN STELLARATOR. Diky, A. G.; Kalinichenko, S. S.; Konovalov, V. G.; Kravchin, B. V.; Ovchinnikov, S. S.; Pavlichenko, O. S.; Pashnev, V. P.; Perepyolkin, N. F.; Suprunenko, V. A.; Tarasenko, V. F. (Physical-Technical Inst., Kharkov). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Experiments on hf plasma heating in the "Uragan" stellarator using ion cyclotron and ion–ion hybrid waves are reported. These waves were excited by means of a coupler that produces an azimuthal hf magnetic field in a plasma and was arranged on a stellarator ceramic section. Such a coupler excites a wide spectrum of spatial hf field harmonics, so the field energy is distributed between these axial harmonics. Plasma (with a density in the range of 10^{12} to 10^{13} cm^{-3}) was produced by ohmic heating associated with hf heating or by hf discharge only. Hydrogen, helium, or hydrogen plus deuterium plasmas were studied. (GE)

9125 NUMERICAL ANALYSIS OF LASER, CONCENTRIC, CONDUCTIVE HEATING OF TWO-TEMPERATURE PLASMA. Gluchowski, W.; Kaliski, S.; Rusinowicz, T.; Smolarek, K. (Inst. of Fundamental Technological Problems, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 21: No. 7-8, 595-603(1973).

Numerical solutions are given for laser, concentric heating of two-temperature D–T plasma, based on the mechanisms of thermal electronic conductivity. The results show the validity of the asymptotic formulas and their usefulness in the estimation of the effects of thermal cumulation on concentric laser heating of spherical and cylindrical systems of D–T plasma. (auth)

9126 ION HEATING BY DRIFT TWO-STREAM INSTABILITY IN A QUASI-NEUTRAL ELECTRON BEAM. Kitagawa, Y.; Maekawa, T.; Tanaka, S. (Kyoto Univ.). Phys. Lett.; 45A: No. 6, 457-458(5 Nov 1973).

In a quasi-neutral electron beam the drift two-stream instability is observed. It is shown that the ion temperature perpendicular to a magnetic field depends strongly on the amplitude of the instability. (auth)

9127 PARALLEL HEAT TRANSPORT IN DOUBLET DISCHARGES. Jensen, T. H.; Fisher, R. K.; Hsieh, C. L.; Ohkawa, T. (Gulf General Atomic Co., San Diego, CA). Phys. Lett.; 45A: No. 6, 461-462(5 Nov 1973).

Experiments in the Doublet II device show that the magnetic

configuration makes a transition at a critical temperature. A simple model of energy balance between the ohmic heat input and the parallel heat conduction seems to explain the experimental results. (auth)

9128 EXPERIMENTAL OBSERVATION OF THE RESONANCES OF A BOUNDED PLASMA IN THE ELECTRON AND MAGNETO-ION DOMAIN. Jusserand, J. J.; Messiaen, A. M.; Weynants, R. R. (Ecole Royale Militaire, Brussels). Plasma Phys.; 15: No. 7, 714-718(Jul 1973).

Preliminary experimental results reported provide support for a theory of power absorption by resonance in a finite plasma cylinder. The plasma was resonantly sustained in a waveguide, and the dependence of the resonances excited on the parameters of the plasma were found to compare well with theoretical predictions. (UK)

9129 COMMENT ON C.J.H. WATSON'S CONCEPT OF NEAR CYCLOTRON RESONANCE HF-SUPPLEMENTED MAGNETOSTATIC MIRROR. Golovanivskii, K. S. (People's Friendship Univ., Moscow). Plasma Phys.; 15: No. 7, 705(Jul 1973).

A recent proposal to reduce cone losses of plasma in mirror machines is examined and found to be less attractive when some peculiarities of the interaction of real plasma with large hf fields are taken into account —peculiarities that cannot be predicted by a single-particle model of plasma. (UK)

9130 NONLINEAR HEATING IN A TOKAMAK PLASMA. Martinov, N. (Univ., Sofia); Samain, A. Plasma Phys.; 15: No. 8, 783-794(Aug 1973).

The possibility of heating a tokamak plasma with the help of a compression wave induced in the plasma by a waveguide system is considered. The frequency of the wave is a high harmonic of the ion cyclotron frequency. Plasma heating cannot occur through linear resonant mechanisms. Heating due to the nonlinear amplification of ion Bernstein modes is studied, taking into account the existence of the magnetic surfaces and the nonuniformity of the static field. The value of the wave field necessary to obtain effective plasma heating is calculated. (auth)

9131 MAGNETIC PUMPING IN SPATIALLY INHOMOGENEOUS MAGNETIC FIELDS. Furth, H. P.; Ellis, R. A. (Princeton Univ., NJ). Plasma Phys.; 15: No. 8, 719-728(Aug 1973).

It is shown that high-frequency magnetic pumping of a toroidal plasma by major-radius oscillation can be implemented experimentally by introducing a major-radius variation of the gradient of the vertical magnetic field, so that perturbations are marginally stable. Various radial-compression cycles are analyzed in terms of motion of the plasma. Ways in which radial compression can be helpful in raising the plasma temperature are discussed. (UK)

Diagnostics

9132 (CEA-CONF-2432) METHODS OF MEASUREMENT FOR THE STUDY OF PLASMA IN THE TFR. Etievant, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd]. 60p. (In French). (CONF-730574-3). Dep. NTIS (U. S. Sales Only) $5.00.

From congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

Plasma diagnostic methods used to study the main parameters of the plasma confined in the TFR (electron and ion temperature, current density), the electrical behavior of the discharge, the densities of neutral gas and impurities, and the parameters of plasma turbulence are presented. (FR)

9133 (CONF-731114-10) MECHANICAL AND OPTICAL COUPLING OF A THOMSON SCATTERING LASER T_e MEASUREMENT TO THE ORMAK MACHINE. Culver, J. S.; Murakami, M. (Oak Ridge National Lab., Tenn. (USA)). 1973. 11p. Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A combination laser, spectrometer device was constructed to observe the electron density and temperature of the ORMAK plasma by Thomson scattering in the range of 50 eV to 2 keV. The apparatus can observe the plasma at six radial positions and fire four 30-ns pulses of Q-switched ruby-laser light during an ORMAK shot. The apparatus and some of its optical components are described. (auth)

9134 THEORY AND OPERATION OF THE SPLIT LANGMUIR PROBE. Bering, E. A. (Univ. of California, Berkeley); Kelley, M. C.; Mozer, F. S.; Fahleson, U. V. Planet. Space Sci.; 21: No. 11, 1983-2001(Nov 1973).

An instrument, the split Langmuir probe, was developed to make in situ measurements of current density and plasma bulk flow. The split Langmuir probe consists of two conducting elements separated by a thin insulator that shield each other over a 2π solid angle and that are simultaneously swept from negative to positive potentials with respect to the plasma. By measuring the current to each plate and the difference current between plates, information can be obtained on the plasma's current density, bulk flow, electron temperature, and density. The instrument was successfully test flown from Fort Churchill on August 2, 1968, with results in reasonable agreement with those from another experiment on the same rocket. Sources of error indicated by these results include plate area differences, plate work function differences, input resistor differences, and probe wake effects. The error signal in the difference current data due to plate work function differences rose to a sharp maximum at plasma potential, which served the useful purpose of precisely marking plasma potential. Possible changes in probe geometry, sweep rate, and telemetry designed to reduce these errors are discussed. (auth)

9135 DIFFERENTIAL SYSTEM FOR MAGNETIC PROBE MEASUREMENTS. Ignat, D. W.; Heym, A. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Rev. Sci. Instrum.; 44: No. 8, 960-962(Aug 1973).

Use of an integrated circuit differential amplifier and passive RC integration provides magnetic probe signals of large bandwidth untroubled by electric pickup. (auth)

9136 SPATIAL FOURIER ANALYZER FOR PLASMA STUDIES. Ogata, A.; Adati, K. (Nagoya Univ., Japan). Rev. Sci. Instrum.; 44: No. 8, 1130-1131(Aug 1973).

A device is constructed for plasma studies which calculates the Fourier coefficients and power spectral densities of spatially periodic signals and displays their time variations on oscilloscopes with large signal bandwidth of dc to 10 MHz. (auth)

9137 LANGMUIR-PROBE CHARACTERISTICS IN A POSITIVE-ION/NEGATIVE-ION PLASMA. Woolsey, G. A.; Plumb, I. C.; Lewis, D. B. (New England Univ., Armidale, Australia). J. Phys., D (London); 6: No. 16, 1883-1890(26 Oct 1973).

Cylindrical-probe measurements were made in an iodine-vapor plasma containing a ratio of negative ions to electrons sufficiently large for electron effects to be neglected; that is, in a positive-ion/negative-ion plasma. The ion–ion plasma was produced by allowing plasma from the Faraday dark space of a dc iodine glow discharge to diffuse into a side arm. Almost symmetrical current–voltage probe characteristics were obtained in the ion–ion plasma, and both the positive- and negative-current regions were found to follow a $(\text{current})^{\frac{2}{3}}$–voltage relationship, as would be expected if ion collection by the probe was orbital-limited. The characteristics were analyzed using orbital-limited current theory to provide data on plasma potential, ion number density, and Debye length. The results of the analysis are consistent with the dominant ion species in the ion–ion plasma being I_2^+ and I_3^-. (auth)

9138 DETERMINATION OF PLASMA ELECTRON DENSITY FROM REFRACTION MEASUREMENTS. Schreiber, P. W.; Hunter, A. M.; Smith, D. R. (Aerospace Research Labs., Wright-Patterson AFB, OH). Plasma Phys.; 15: No. 7, 635-646(Jul 1973).

The mathematical analysis developed allows the axial electron density of an axisymmetric plasma to be determined without inverting an integral equation. The required input includes the angle of refraction of a laser beam as a function of incident-beam lateral displacement. Data at several wavelengths are required to eliminate contributions to the refractivity due to atoms and ions. Analysis of the data yields electron densities in good agreement with thermodynamic calculations. (auth)

9139 USE OF DIFFUSING INDUCTIVE FIELDS OF A RELATIVISTIC BEAM–PLASMA SYSTEM TO DETERMINE PLASMA CONDUCTIVITY. Prono, D. S.; Lee, E. P. (Univ. of California, Livermore). Plasma Phys.; 15: No. 7, 691-698(Jul 1973).

A technique to measure the conductivity profile of the plasma produced when an intense relativistic electron beam passes through a neutral gas is discussed. The analysis shows that measurements of the radial and temporal variation of inductive field strengths may be used to determine both the plasma conductivity and channel radius. (auth)

9140 SCATTERING OF LASER LIGHT FROM A PULSED ARC PLASMA. Berney, A. (Univ. of British Columbia, Vancouver). Plasma Phys.; 15: No. 7, 699-704(Jul 1973).

The plasma produced in an "hour glass" shaped discharge tube was used as a scattering medium for the light of a ruby laser. The scattered light was observed in various conditions. The values of the scattering parameter $\alpha = 1/|k|D$ ranged from 0.9 to 1.3. The

shapes of the spectra obtained for a helium plasma are in good agreement with those predicted by the theory of light scattering by a plasma in thermal equilibrium. No anomalies, in particular no satellites related to the plasma frequency, were observed. (auth)

Kinetics (General)

Refer also to abstract 8585.

9141 (CEA-CONF-2371) EFFECT OF THE SCATTERING OF ELECTRONS ON THE DISTRIBUTION FUNCTION AND THE BALANCE OF ELECTRONIC ENERGY IN POST-DISCHARGE HELIUM. Monchicourt, P.; Touzeau, M.; Wells, W. E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Atomique). 24 May 1973. 19p. (In French). (CONF-730574-6). Dep. NTIS (U. S. Sales Only) $3.00.

From congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

The deexcitation of metastable atoms and molecules in the afterglow of a weakly ionized helium gas leads to the creation of hot electrons having energies of between 15 and 20 eV. The energy relaxation of these electrons was studied under conditions where the diffusion is not negligible. The expression for the coefficient of diffusion together with considerations on the space charge created by the total electron energy distribution enables calculations to be made of the number of electrons disappearing during the relaxation process and the perturbation resulting in the Maxwellian distribution. The importance of this effect is given for some particular experimental cases. (FR)

9142 (FRNC-TH-400) MICROWAVE PARAMETRIC AMPLIFICATION IN GAS PLASMAS AND ELECTRON BEAMS. Naoulo, M. (Paris-11 Univ., 91 - Orsay (France)). 1972. 95p. (In French). Dep. NTIS (U. S. Sales Only) $6.75.

Thesis.

A theory is developed for the parametric amplification of traveling waves which takes into account the existence of a finite-valued confining magnetic field as well as the radial and azimuthal motion of the electrons. Three cases are dealt with: an electron beam, a plasma column, and a mixed beam–plasma system. The beam–plasma system is a cylindrical column of finite radius maintained under vacuum. The ionized gas is modulated by the pump. The signal which is subsequently injected is amplified by coupling it with the pump, this being possible as a result of the nonlinear properties of the system. Linear analysis of the dispersion yields the propagation parameters of the separately injected waves. The simultaneous excitation modifies these parameters. An analysis of the propagation of the waves, taking into account second-order nonlinear terms, enables the nonlinear component of the current density to be obtained. An experimental device was constructed in which the waves are injected in a beam–plasma column. The power level of the waves was measured along the entire length of this column in order to determine the parametric gain. The column was obtained by plasma diffusion from a hollow cathode discharge. The variations in the paramagnetic gain are presented as a function of the powers and frequencies of the waves as well as a function of the beam–plasma medium. The following cases were analyzed: plasma only, beam only, pump frequency of less than the signal frequency, generation of waves, and the gain for waves with a frequency equal to the sum of the plasma and beam frequencies. (FR)

9143 (JPRS-60533) COMPLEX EFFECTS OF RADIATION FOR MOVING SOURCES IN PLASMA. Sorokin, Yu. M. Translated from Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 16: No. 3, 342-350(1973). 14p. NTIS.

Angular and frequency spectra of the radiation of sources uniformly moving in isotropic plasma were measured. The aberrational nature of complex effects of the radiation was made clear. It was found that, in a certain frequency band, the radiation of a monochromatic source isotropic in the accompanying system K' has a limited angular spectrum in the system K connected with the medium, whereas for emitters beam-directed in K', with a finite band, the radiation pattern can be substantially widened for an observer in the system K. Special features of the time structure of received signals were examined. It was found, in particular, that in some cases the radiation of a source isotopic in K', continuously emitting from the moment t_0, is received at a fixed point of the system K only in the course of a finite time. The possibilities of observing the effects under consideration are discussed. (auth)

9144 (JUL-972-PP) BREMSSTRAHLUNG IN THE INFRARED OF A DENSE PLASMA FOCUS. Gollwitzer, D. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Plasmaphysik). Jul 1973. 42p. (In German) Dep. NTIS (U. S. Sales Only) $4.25.

Thesis. Submitted to Bochum Univ. (West Germany).

It was shown that the radiation emitted during the dense phase of a plasma focus cannot be explained by the radiation theory valid for two-particle collisions, but that collective effects must be assumed which lead to the observed nonthermal radiation of the plasma. The radiation found can be explained as radiation with the double plasma frequency. It is conceivable that the plasma focus, besides its property as an economical pulsed neutron source, can be used as a light source of extremely strong intensity in the longwave spectral range. The nonthermal and thermal intensity of the plasma focus can be increased by a factor of 2 to 3 by choosing another electrode material, e.g., copper. The intensity of the thermal radiation is dependent on the square of the atomic number. If one could control and change the percentage of heavy ions in the plasma, then the dependence of the nonthermal radiation on the atomic number could be determined. (GE)

9145 (JUL-973-RW) EXAMINATION OF THE PHYSICAL AND SPECTROCHEMICAL CONDITIONS OF THE ARC DISCHARGE UNDER INERT GAS PRESSURE UP TO 40 ATMOSPHERES. Keintzel, G. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorwerkstoffe). Jul 1973. 113p. (In German). Dep. NTIS (U. S. Sales Only) $7.75.

Examinations with a dc arc at high pressure showed that the discharge in a helium atmosphere, compared to argon, is accompanied by convection-effected instabilities. They occur at pressure > 20 atm He, and in analytic work, they are responsible for an insufficient consistency of the spectrochemical results. A considerable improvement of the reproducibility can be obtained by installing a homogeneous, longitudinal magnetic field, since at field intensities between 100 and 200 G a stabilization of of the arc discharge occurs. Under these conditions it is possible to perform a quantitative, spectrochemical analysis in a helium atmosphere up to 40 atm. The higher ionization potential of helium, compared to argon, causes a higher arc-operating voltage and a greater electric field intensity in the discharge space. The greater field intensity results in a strong acceleration of the charged particles in the near-electrode regions and, for the case of the helium-high-pressure arc, leads to erosion figures at the cathode and anode. Plasma-diagnostic, spectroscopic measurements on a helium arc showed a linear relation between discharge pressure and arc temperature or electron pressure in the pressure range from 10 to 40 atm. The helium high-pressure arc has a small discharge channel in which temperature and electron density have a strong radial decreasing. It was possible to demonstrate this clearly by interference-optical exposures. (auth)

9146 (ORO-3293-2) STABILITY OF MOVING PLASMA CELLS. Final Report. (Miami Univ., Coral Gables, Fla. (USA). Dept. of Physics). 1972. Contract AT(40-1)-3293. 4p. Dep. NTIS $3.00.

The hot plasma produced by colliding plasmoids in magnetic mirror fields is discussed. Densities of the order of 10^{16} ions/cm^3, temperatures of the order of hundreds of electron volts, and confinement times of tens of microseconds have been attained. Conical theta-pinch guns produce the plasmoids. A description of the TRISOPS III machine with secondary compression mirrors is given along with some experimental results. (MOW)

9147 (SLA-73-872) SPECTROSCOPIC INVESTIGATION OF THE ANODE PLASMA OF A PULSED VACUUM ARC. Bacon, F. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 71p. Dep. NTIS $5.75.

A spectrocopic investigation was made of the anode plasma of a pulsed vacuum arc with an aluminum anode and a molybdenum cathode. The arc was triggered by a third trigger electrode and was driven by a 100- or 150-A, 10-μsec current pulse. The average current density at the anode was sufficiently high that anode spots were formed; these spots were the source of the aluminum plasma investigated in this experiment. By simultaneously measuring spectral emission lines of Al I, Al II, and Al III, the plasma electron temperature was shown to decrease sequentially through the norm temperatures of Al III, Al II, and Al I as the arc was extinguished. The Boltzmann distribution temperature of four Al III excited levels was shown to be 2.0 ± 0.5 eV, and the peak Al III 4D excited-state density was shown to be about 5×10^{11} cm^{-3}. The plasma was theoretically shown to be optically thin to the observed Al III spectral lines. Production of Al III was shown to occur at distances less the 0.1 mm from the anode surface, and the spectroscopic data indicated that Al III was ionized at distances up to 0.3 mm from the anode surface. (auth)

9148 (TRITA-EPP-73-8) PLASMA STREAM IN AN INHOMOGENEOUS TRANSVERSE MAGNETIC FIELD. Karlson, E. T. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik). Mar 1973. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

The adiabatic motion of a finite plasma stream in an inhomoge-

neous, transverse magnetic field is studied. The magnitude of the magnetic field varies only in the direction of the initial stream velocity, and the width of the stream is much smaller than the characteristic length for the variation of the magnetic field. It is shown that, for a cold plasma, the stream velocity is constant and the width of the stream is inversely proportional to the magnitude of the magnetic field. The stream is not deflected. For a hot plasma, the stream velocity decreases with increasing magnetic field, and if the field is strong enough, the stream will be stopped completely. The width of the stream decreases with increasing magnetic field, but is again increased when the stream velocity becomes very low. The stream is always deflected in the direction of ion gradient drift, but the amount of deflection depends strongly on the width of the stream. (SW)

9149 NONLINEAR MOTION OF A WEAK INHOMOGENEITY IN A MAGNETOACTIVE PLASMA. Giles, M. J. (Univ. of Sussex, Brighton, Eng.). Planet. Space Sci.; 21: No. 11, 1855-1862(Nov 1973).

The equations of motion of a magnetic field aligned column of ionization embedded in an unbounded weakly ionized plasma immersed in an external electric field, E, are solved to second-order terms in the strength of the initial perturbation, which is assumed to be weak. It is shown that, when the Hall currents induced by the internal electrostatic field are taken into account, the center of mass of the column will, in general, move along a curved path before acquiring the familiar $E \times B/B^2$ drift velocity. (auth)

9150 EFFECT OF FLUCTUATIONS ON DIFFUSION IN THE PROTO-CLEO STELLARATOR. Lees, D. J. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The effect of fluctuations on diffusion can be found from the phi component of the force equation. Measurements of the fluctuation density and electric field show that these fluctuations do not balance the diffusion flux in the PROTO-CLEO stellarator. (GE)

9151 NONADIABATIC MOTION OF PARTICLES IN INHOMOGENEOUS MAGNETIC FIELDS. Krushkal, E. M. (Inst. of Nuclear Physics, Novosibirsk, USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 17: No. 11, 1792-1795(May 1973).

Translated from Zh. Tekh. Fiz.; 42: No. 11, 2288-2294(Nov 1972).

Equations are obtained for the nonadiabatic change of the magnetic moment $\Delta\mu$ in the motion of particles in a magnetic dipole field, and for a certain class of inhomogeneous axisymmetric magnetic fields. Refinements are made for the dependence of $\Delta\mu$ on the angle between the velocity vector and the direction of the magnetic field at the field minimum. (auth)

9152 ANOMALY OF PLASMA ELECTRICAL CONDUCTIVITY IN A MAGNETIC FIELD. Barkov, A. P.; Burchenko, P. Ya.; Volkov, E. D.; Kutsin, A. A.; Masnichenko, M. E.; Pabvlichenko, O. S.; Rubtsov, K. S.; Suprunenko, V. A.; Sukhomlin, E. A. (Physical-Technical Inst., Kharkov). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

It was found in the "Sirius" stellarator and in the linear discharge "Grom" that stabilization levels of current velocity is a function of the ratio between electron-cyclotron and plasma frequencies. To estimate the strength of microfields and evaluate the level of turbulent noise in the "Sirius" stellarator, the technique of satellite observations in the vicinity of forbidden helium spectral lines was used. (GE)

9153 DISCRETENESS OF PULSED PLASMA STREAMS. Morozov, V. A. Zh. Prikl. Mekh. Tekh. Fiz.; No. 4, 187-189 (1973). (In Russian).

Discrete plasma formations were investigated in pulse plasmatrons by photoscanning the gas discharge stream at fourfold magnification. The clearest discrete structure was noted for electrodes made of W or C. The low-melting metals (Pb, Sn, Al, Cu, and Fe) did not show bright areas on the photographs or a spacial separation of separate discrete waves. The separate discrete areas have a size comparable to the radial cross section of the stream. These areas have the form of thin disks. On both sides of the central, brightest part of the stream it is possible to see periodic densified regions (zones of higher brightness). In the initial stages of the discharge, the discontinuous structure of the stream is not observed for a period of 6 to 8 msec; then indistinct discontinuous formations appear (9 to 12 msec), and finally the stream takes on the appearance of a clear discrete structure. This discharge is a complex formation in which along with plasma microbundles there are compression and rarefaction waves which propagate at sonic velocities in the closed volume of the stream. These waves also create perturbations in the stream which are detected in the form of periodic areas of increased brightness (compression waves), separated by dark areas (rarefaction waves). The explosive evaporation processes on the electrodes may be the source of these compression and rarefaction waves. (SJR)

9154 TWO-TEMPERATURE MODEL OF A PLASMA UNDER CONDITIONS OF STEADY-STATE GAS FLOW THROUGH A PLASMATRON. Dresvin, S. V. Zh. Prikl. Mekh. Fiz.; No. 4, 3-12(1973). (In Russian).

The results of calculations on a cylindrical arc in a channel with gas purging are presented on the basis of a two-temperature plasma model. It is shown that the gas purge leads to the appearance of a substantial discontinuity in the electron and gas temperature near the walls of the plasmatron and in the precathode zone. The possibilities of the two-temperature model are analyzed from the point of view of approximately calculating the electron temperature in arc and induction plasmatrons. It is shown that from simple relationships it is possible to estimate the electron temperature with an accuracy of at least 10% for induction plasmatrons, and 15 to 20% for arc plasmatrons. (auth)

9155 INVESTIGATION OF IMPURITY DIFFUSION IN A TOKAMAK BY SPECIAL METHODS. Gervids, V. I.; Krupin, V. A. JETP Lett. (USSR) (Engl. Transl.); 18: No. 2, 60-62 (20 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 2, 106-109(20 Jul 1973).

By comparing the experimental and calculated carbon impurity ion intensity lines in a tokamak hydrogen plasma, it is shown that the ions diffuse towards the pinch axis. The densities of the impurity-ion diffusion flux and the contribution of the impurities to the proton diffusion flux are estimated. (auth)

9156 SOME RESULTS OF EXPERIMENTAL INVESTIGATION OF THE CURRENT-SHEATH EFFECT. Kerkis, A. Yu.; Sokolov, V. S.; Trynkina, N. A.; Fomichev, V. P. (Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR; 211: No. 1, 69-72(1 Jul 1973). (In Russian).

The results of experiments on the current-sheath effect in a regime of its spontaneous excitation in plasma expansion in a disk channel in the presence of a transverse magnetic field are presented. For a 1000-Oe magnetic field, the process develops due to purely gasdynamic factors. For a 3000-Oe field, the dynamic process is in the center of the channel, which has a larger radius, and around the center is a light ring that rapidly increases in intensity and width. Conditions of formation of the current sheath were established. (auth)

9157 RELATIONSHIP BETWEEN NONLINEAR SUSCEPTIBILITIES AND FLUCTUATIONS IN PLASMA. Sitenko, A. G. (Inst. of Theoretical Physics, Kiev). Dokl. Akad. Nauk SSSR; 211: No. 1, 79-82(1 Jul 1973). (In Russian).

Equations derived indicate that electrodynamic (linear and nonlinear) properties of plasma are completely determined if the sequence of correlation functions of different orders are given for fluctuations in charge density with negligible interaction between particles. The equations may be considered as generalized fluctuation–dissipation relations for cases of nonlinear electrodynamic media. (auth)

Kinetics (Experimental)

9158 INTERFEROMETRIC MEASUREMENTS OF THERMODYNAMIC VARIABLES OF RARE GAS PLASMAS PRODUCED BY SHOCK WAVES. Meiners, D.; Weiss, C. O. (Technische Univ., Hanover). Z. Naturforsch.; 28a: No. 8, 1294-1307(1973). (In German).

The variation of electron density and neutral atom density behind incident shock waves in argon, krypton, and xenon are measured using a two-wavelength laser interferometer with photoelectric detection of fringe shifts. The accuracy of the measured area densities $\int N_e dl$ and $\int N_0 dl$ is better than 1%. Densities measured at the moment of maximum electron density agree well with Rankine–Hugoniot densities. There are no indications to deviations from LTE. Additionally, in the radiation cooling region the decrease of temperature is determined. (GE)

9159 X-RAY EMISSION FROM LASER-CREATED PLASMAS. Floux, F.; Cognard, D.; Saleres, A.; Redon, D. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). Phys. Lett.; 45A: No. 6, 483-484(5 Nov 1973).

A 10-GW neodymium laser beam is focused on a solid deuterium target. The soft and hard components in the x-ray emission of the plasma are analyzed. (auth)

Kinetics (Theoretical)

9160 (CEA-CONF-2387) APPROXIMATE TREATMENT OF ION DYNAMICS IN STARK BROADENING THEORY. Segre, E. R.; Voslamber, D. (Observatoire de Paris, Section deMeudon, 92 (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1972. 5p. (CONF-730906-13). Dep. NTIS (U. S. Sales Only) $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

Time ordering in the low-frequency part of the time-evolution operation that enters the general line-shape formula is discussed. The advantage of using a time-ordering approximation over other methods of analysis is described. Line-shape formula is given. (MOW)

9161 (CONF-731114-7) OPERATING REGIMES OF FUTURE TOKAMAK REACTORS ACCORDING TO NEOCLASSICAL THEORY. Stacey, W. M. Jr. (Argonne National Lab., Ill. (USA)). 1973. 5p. Dep. NTIS $3.00.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Current tokamak theory is extrapolated to predict the characteristics of future reactor regimes and to examine certain transport effects in those regimes. (auth)

9162 (COO-2059-28) RELAXATION RATE OF A TWO-DIMENSIONAL MAGNETIZED PLASMA MODEL. Hsu, J. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Dec 1973. Contract AT(11-1)-2059. 79p. Dep. NTIS $6.00.

Thesis.

The thermal relaxation of a two-dimensional single-species plasma model is investigated. The numerical results in the unmagnetized case are consistent with those of Montgomery and Nielson when the mesh size of the computational grids is equal to a Debye length. It is shown that a smaller mesh size makes the relaxation faster. The secular term in the kinetic equation arising from the calculation of the energy exchange of a two-particle system along the unperturbed orbit is well interpreted and overcome by the introduction of the drift of the guiding center. For weak magnetic fields, the pair correlation is enhanced and makes the relaxation time shorter than that in the absence of a magnetic field. Calculating the electric field fluctuation based upon the uncorrelated finite gyroradius model, it is shown that the first cyclotron mode has a maximum at $\Omega \cong 2.5\ \omega_{pe}$. When the cyclotron frequency $\Omega \cong 2\ \omega_{pe}$, the relaxation is fastest. In the strongly magnetized regime, the relaxation time is proportional to $\sqrt{n_0\lambda_D^3}$ and B. In the case of weaker magnetic fields, there is a transition to the unmagnetized regime in which the relaxation time varies as $n_0\lambda_D^3$. (auth)

9163 (EUR-CEA-FC-698) STUDY OF NONLINEAR SOLUTIONS OF THE VLASOV EQUATION USING THE WATER-BAG MODEL. Finzi, U. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Jun 1973. 112p. (In French). Dep. NTIS (U. S. Sales Only) $7.75.

Thesis.

Nonlinear solutions of the Vlasov–Poisson system for a one-dimensional plasma model are studied. A double water-bag electron distribution function with a uniform motionless ion background is considered. The properties of the complete family of steady-state solutions are discussed and conditions for the existence of periodic and aperiodic equilibria are calculated. The problem of the stability of aperiodic stationary states is completely solved by a perturbation technique. Results are found to be in agreement with a sufficient condition for instability derived from thermodynamic theory. The time evolution of a linearly stable two-stream system towards an exact nonlinear periodic stationary state is shown to take place using computer experiments, with suitably chosen initial conditions. (FR)

9164 (LPS-117) DIFFUSION THEORY OF STRONG, STABLE E LAYERS. Humphries, S. Jr. (Cornell Univ., Ithaca, N. Y. (USA). Lab. of Plasma Studies). May 1973. Contract AT(11-1)-3170. 26p. Dep. NTIS $3.50.

A diffusion theory is presented that treats the long-term behavior of strong electron rings (E layers) with and without an applied toroidal field. Loss rates and decay characteristics are predicted that are in good agreement with experimental results from the Astron and the Cornell relativistic-electron coil experiment. Self-consistent density distributions and changes of the E-layer energy are also discussed. The average radius of the layer as a function of energy, magnetic fields, and surrounding conducting boundaries is calculated for typical experimental situations. (auth)

9165 (LPS-135) RESISTIVE TRAPPING OF RELATIVISTIC ELECTRON BEAM INJECTED INTO A TORUS. Sudan, R. N. (Cornell Univ., Ithaca, N.Y. (USA). Lab. of Plasma Studies). Oct 1973. 7p. Dep. NTIS $3.00.

A steady-state divertor excited by external currents is used. The electron-beam cathode is located on a line of force just outside the separatrix and the outer conducting wall is the anode. The beam propagates along the tube of force passing through the cathode. Equations describing the motion of the beam and its interaction effects with currents in the device are discussed. (MOW)

9166 (TRITA-EPP-73-12) PRESSURE DISTRIBUTION AND STABILITY OF A MAGNETIZED PLASMA WITH A NEUTRAL GAS BLANKET. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Plasmafysik med Fusionsforskning). 19 Jun 1973. 45p. Dep. NTIS (U. S. Sales Only) $4.25.

The steady-state fully ionized plasma column considered is immersed in an axial magnetic field and surrounded by a neutral gas blanket: (i) The Nernst effect tends to produce a pressure which decreases in the radial direction. This effect can sometimes be outbalanced by radial motions produced by thermonuclear reactions and/or by a local extraction of plasma. (ii) The steady-state pressure distribution is sensitive even to small radial velocities. In principle, therefore, it is possible to regulate the distribution by external means, such as by plasma extraction and injection. Magnetically shielded supports offer a unique possibility in this connection. (iii) A scheme for flute and ballooning instability suppression is proposed as an alternative to minimum-average-B stabilization. The scheme is based on the effects of viscosity, the finite Larmor radius, and line-tying and limiter action, in combination with external-pressure-gradient control by plasma extraction and injection. (iv) There exists an upper limit of the neutral-gas-blanket density for which the plasma balance becomes possible at a given heating power. (auth)

9167 DIRECTIONAL TRANSPORT EQUATIONS FOR PLASMAS. Wang, P. K. C. (Univ. of California, Los Angeles). Z. Phys.; 263: No. 1, 15-24(1973).

The equations governing the directional transport of plasmas are derived from Boltzmann's equation by averaging over a given subset of the velocity space. Their application to plasma confinement by means of external time-dependent electromagnetic fields is discussed. (GE)

9168 SCATTERING FUNCTION OF A TWO-COMPONENT FULLY IONIZED GAS. Cheng, C. S. (East Stroudsburg State Coll., PA). J. Math. Phys. (N. Y.); 14: No. 7, 947-956(Jul 1973).

The effects of collisions on the scattering function of a two-component fully ionized gas are discussed, using an improved Brownian-motion-type collision model. In the collision model, the particle numbers as well as the energy and the linear momentum are conserved; and the electron–ion collisions are taken into account. The dispersion relations are discussed in detail, and explicit calculations are carried out for the scattering function and the energy-loss function in the long-wavelength approximation when the wavelength is greater than the mean free path and the Debye length. The damped plasma oscillations dominate the energy-loss function; while for the scattering function, thermal diffusions and sound propagations dominate the low-frequency region and contribute most to the total scattering cross section. The contribution from the damped plasma oscillations to the scattering becomes important only for high frequencies near the plasma oscillation frequency. (auth)

9169 TRANSPORT COEFFICIENTS OF FULLY IONIZED PLASMA. Midha, J. M.; Gupta, S. C. (Punjabi Univ., Patiala, India). Nuovo Cim.; 18B: No. 1, 123-130(11 Nov 1973).

Expressions of various transport coefficients for a fully ionized plasma are derived in the presence of steady magnetic field and time-dependent electric field within the framework of the Grad's thirteen-moment method. (auth)

9170 STOCHASTIC KINETIC THEORY FOR PLASMA IN STRONG ELECTROMAGNETIC FIELDS. II. Friction and Diffusion Terms. Masselot, C.; di Bona, G. (Commissariat a l'Energie Atomique, Villeneuve-Saint-Georges, France). Nuovo Cim., 18B: No. 1, 131-143(11 Nov 1973).

In an earlier work, by means of a stochastic method, a set of two kinetic equations was obtained governing, in the first order, the interaction of an electron plasma with a strong electromagnetic wave. The solution of this set of equations leads to the computation of the friction and diffusion terms of the evolution equation for the one-particle distribution function. This evolution equation turns into the Balescu–Lenard equation when the external field is set equal to zero. (auth)

9171 PROBABILISTIC MODEL OF PLASMA TURBULENCE. Tessarotto, M. (Univ., Trieste, Italy). Lett. Nuovo Cim.; 8: No. 10, 605-610(3 Nov 1973).

A spatially homogeneous plasma without external fields is considered. Considerations are limited to a one-dimensional system. A perturbation expansion for the average distribution function, neglecting modal coupling effects, is used. The analysis is restricted to a second-order perturbation expansion in the field intensity. It is shown how the weak-velocity-dependence assumption can be relaxed. This leads in turn to a significant modification in the diffusion coefficient and in the dielectric function. (MOW)

9172 COULOMB-COLLISION CORRECTED ELECTRON-PLASMA LINE PROFILES. Niimura, M.; Chan, P. W.; Churchill, R. J. (Colorado State Univ., Fort Collins). J. Phys. Soc. Jap.; 34: No. 6, 1611-1619(Jun 1973).

Complete profiles of Coulomb-collision corrected electron-plasma line including both electron–ion (e–i) and electron–electron (e–e) collisions were computed. The line profiles are presented graphically for specific experimental conditions and are compared to those obtained from collisionless plasma theory. It is seen that, in the collision-dominated regime, the electron–ion collisions play an important role, while in the transition regime, the electron–electron collisions control the damping of the plasma line. In both cases, collisions broaden the line-width significantly over the Landau (collisionless) width, while the peak is compensatingly reduced such that the integrated line intensity remains constant. In addition, the resonance frequency is found to be shifted toward higher frequencies due to the effect of Coulomb collisions while the line shape remains approximately Lorentzian. Possible experimental conditions wherein these Coulomb collisional effects may be observed by light-scattering techniques are discussed. (auth)

9173 EQUILIBRIUM VACUUM MAGNETIC FIELD OF AN AXISYMMETRIC TORUS WITH AN ELLIPTICAL PLASMA CROSS-SECTION. Tanaka, M.; Tuda, T.; Azumi, M. (Japan Atomic Energy Research Inst., Tokai). J. Phys. Soc. Jap.; 34: No. 6, 1641-1644(Jun 1973).

A method for obtaining a vacuum magnetic field around a prescribed axisymmetric toroidal plasma equilibrium is described. The equilibrium vacuum field, which fits the boundary conditions on the plasma–vacuum interface, is obtained assuming a large aspect ratio. The equilibrium solution is given explicitly for an elliptical plasma cross section, and the singularities of the resultant magnetic field are examined. (auth)

9174 PLASMA SIMULATION WITH FEW PARTICLES. Knorr, G. (Ames Lab., IA). AT(11-1)-2059. J. Comput. Phys.; 13: No. 2, 165-180(Oct 1973).

A numerical method of plasma simulation is described which allows one to simulate Vlasov plasmas with very few degrees of freedom. Linear effects can be simulated by an amount of information corresponding to less than 100 particles; nonlinear effects require less than 500 "particles" in one spatial and one velocity dimension. The method is based on replacing the infinite real eigenvalue spectrum of the free-streaming terms of the Vlasov equation by a finite discrete spectrum. An imaginary damping term is artificially added to the eigenvalues and, thus, recurrence effects are minimized. (auth)

9175 ALTERNATING DIRECTION IMPLICIT TECHNIQUES FOR TWO-DIMENSIONAL MAGNETOHYDRODYNAMIC CALCULATIONS. Lindemuth, I. (Univ. of California, Livermore); Killeen, J. J. Comput. Phys.; 13: No. 2, 181-208(Oct 1973).

Alternating direction implicit numerical techniques for solving time-dependent, two-dimensional, two-fluid MHD equations are presented. The techniques are illustrated with applications to the dynamics of a theta pinch and the expansion of a laser-produced plasma, and important features of both cases are demonstrated. The enhanced numerical stability of the method is discussed. (auth)

9176 SIMULATION OF TOKAMAK CONFINEMENT PROBLEMS ON FM-1. Chen, K.; Meade, D.; Okabayashi, M.; Schmidt, J. A.; Yoshikawa, S. (Princeton Univ., NJ). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Plasma confinement was studied in FM-1 with magnetic configurations and plasma parameters that simulate microstability properties of tokamaks. The near-classical (pseudoclassical) confinement in the spherator mode of FM-1 becomes Bohm-like when the electron temperature is increased. Increasing the toroidal field by a factor of 4 to simulate a tokamak configuration causes the confinement to decrease by a factor of ~ 5. FM-1 was operated in three different magnetic configurations which were determined by the ratio of the currents which produced the toroidal, poloidal, and external vertical fields, respectively. Important properties of the field configurations are summarized for a flux surface near maximum density gradient at the outer edge of the plasma. The results of these FM-1 tokamak-simulation experiments suggest that trapped-particle effects, most likely a dissipative trapped-particle instability, may limit the confinement on existing tokamaks to approximately 60 Bohm times. (GE)

9177 EFFECTS OF NEUTRAL INJECTION UPON TOROIDAL PLASMA EQUILIBRIA. Connor, J. W.; Cordey, J. G. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The equilibrium distribution functions of the three-species plasma (high-energy ions, background ions and electrons) is derived. First, the high-energy ion distribution is found from a solution of an appropriate Fokker–Planck equation that takes into account the toroidal geometry, then the plasma current is calculated from the electron distribution function. Finally, the influence of ripples in the toroidal field upon the toroidal velocity of the background plasma is evaluated. (GE)

9178 FLUCTUATIONS, ANOMALOUS TRANSPORT, AND PARTICLE SCATTERING IN TOROIDAL PLASMAS. Coppi, B. (Massachusetts Inst. of Tech., Cambridge). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Modes that are typical of toroidal plasmas can be excited, in high-temperature regimes, and lead to new particle orbits that can be distinguished as trapped quasi-banana, quasi-circulating, and circulating orbits. The radial width of quasi-bananas can be considerably larger than that of the known banana orbits and, as a consequence, a significant diffusion may result from the collisional scattering of them. In particular, the modes acting on ions are driven by a transverse temperature gradient and, in the absence of collisions, appear to induce a larger ion-thermal-energy transport than the corresponding modes found for one-dimensional configurations. The current-carrying electrons that belong to the circulating population can excite microinstabilities, acting on them like electron–electron collisions, only if they exhibit a finite thermal conductivity along the magnetic field or are represented by a beam-like distribution. (GE)

9179 SCALING LAWS OF PERMEABLE AND IMPERMEABLE TOKAMAK PLASMAS. Lehnert, B. (Kungliga Tekniska Hoegskolan, Stockholm). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The possible parameter ranges and the density limits of tokamak plasmas are determined from a number of fundamental equilibrium and stability conditions, including the effects of plasma–neutral gas interaction. (GE)

9180 COMMENTS ON DRIFT MOTION AND ADIABATIC INVARIANCE OF MAGNETIC MOMENT IN A NONSTATIC MAGNETIC FIELD. Kapetanakos, C. A.; Trivelpiece, A. W. (Univ. of Maryland, College Park). Plasma Phys.; 15: No. 7, 707-709 (Jul 1973).

Some recent results, based mainly on analog computer studies, concerning the motion of charged particles in a homogeneous, time-varying, magnetic field are examined. It is shown that in the case of linearly varying fields an alleged "anomalous drift" is the expected $E \times B/B^2$ drift of the guiding center of the gyrating particle. (UK)

9181 MICROSCOPIC THEORY OF DENSITY FLUCTUATIONS IN PARTIALLY IONIZED GASES. Linnebur, E. J.; Duderstadt, J. J. (Univ. of Michigan, Ann Arbor). Plasma Phys.; 15: No. 7, 647-658(Jul 1973).

A set of exact kinetic equations describing density fluctuations in many-body systems with S species is developed. These equations are applied to the analysis of a partially ionized gas with three species: electrons, ions, and neutral atoms. The relationship of this theory to earlier kinetic-theory investigations is discussed. A simple approximation for the nonlocal, non-Markovian collision kernels in these kinetic equations is introduced and used to compute the dynamic structure factors characterizing the scattering of electromagnetic radiation (both Thomson and Rayleigh) from partially ionized gases. (auth)

9182 TRANSPORT OF CHARGED PARTICLES IN TURBULENT FIELDS: COMPARISON OF AN EXACT SOLUTION WITH THE QUASILINEAR APPROXIMATION. Jokipii, J. R.; Lerche, I. (California Inst. of Tech., Pasadena). Plasma Phys.; 15: No. 7, 619-625(Jul 1973).

The problem of charged-particle transport in a magnetic field that is solely a function of time is considered, and an exact solution is obtained, to all orders in the field, in the limit of large wavelengths normal to the magnetic field. It is shown that the usual quasi-linear, Fokker–Planck approximation is equal to the exact solution in the limit of times large compared to the correlation time of the fluctuating field. (auth)

9183 MHD EQUILIBRIUM OF A SLIGHTLY ASYMMETRIC TOKAMAK. Sestero, A. (Massachusetts Inst. of Tech., Cambridge). Plasma Phys.; 15: No. 7, 709-712(Jul 1973).

The magnetohydrodynamic equilibrium of the tokamak configuration, in the presence of small deviations from axisymmetry, is examined. Differences with respect to the stellarator case are due mainly to the large longitudinal current that circulates in the tokamak configuration. The effects of the main sources of small asymmetries that exist in real tokamak discharges are discussed. (UK)

9184 SINGULARITIES OF THE VACUUM MAGNETIC FIELD AROUND A NONCIRCULAR PLASMA CYLINDER. Tanaka, M.; Iwata, G. (Japan Atomic Energy Research Inst., Tokai). Plasma Phys.; 15: No. 7, 712-714(Jul 1973).

A particular class of cylindrical plasma equilibria with noncircular cross sections is examined. An external vacuum magnetic field is constructed which fits the boundary conditions on the plasma/vacuum interface. Branch points are shown to exist, with sheet currents flowing along the branch cuts to realize the prescribed plasma/vacuum interface. (UK)

9185 GENERALIZED FLUX-VORTICITY THEOREM. I. Buckingham, M. J.; Byrne, J. C.; Burman, R. R. (Western Australia Univ., Nedlands). Plasma Phys.; 15: No. 7, 669-675(Jul 1973).

A generalized conservation theorem, in both integral and differential forms, is obtained for multi-fluid plasmas with currents having relativistic velocities and with inertial effects included. The fluids are represented as pressure-free ideal gases that do not interact by collisions. For each fluid, hydrodynamic sinks of mass are incorporated to allow for recombination. (auth)

9186 BEAM-PLASMA INTERACTION IN ASTRON. Striffler, C. D.; Kammash, T. (Univ. of Michigan, Ann Arbor). Plasma Phys.; 15: No. 8, 729-764(Aug 1973).

The beam-plasma interactions in the Astron device are examined, utilizing a model that consists of a homogeneous, cold, relativistic electron beam (E-layer particles) streaming through a Maxwellian plasma normal to a uniform external magnetic field. Using linear stability analysis, the model shows that the strongest interactions occur at beam harmonics in the vicinity of the plasma normal modes near the upper hybrid frequency, and above each subsequent multiple of the plasma electron cyclotron frequency. The possible stabilizing effects of collisions between plasma electrons and background neutral particles, as well as the energy spread for beam particles are also examined. It is shown that collisional effects are especially strong at collision frequencies of the order of the beam cyclotron frequency and that the combined effects of collisions and energy spread may lead to quenching of the unstable modes. Comparison of the analytical results with experimental observations is presented and discussed. (auth)

9187 NEOCLASSICAL TRANSPORT THEORY OF A PLASMA WITH MULTIPLE ION SPECIES. Connor, J. W. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 15: No. 8, 765-782(Aug 1973).

The neoclassical transport theory in the banana regime for a plasma with an arbitrary number of ion components in an axisymmetric large-aspect-ratio torus is developed. Effects due to density and temperature gradients and a toroidal electric field are considered, using a treatment based on an elaborate collision operator. The case of two ion components is considered in detail, and numerical results are presented for the situation in which one component is a heavy-ion impurity. (auth)

Production

Refer also to abstract 9101.

9188 (N-73-21613) STEADY-STATE HOT-ION PLASMA PRODUCED BY CROSSED ELECTRIC AND MAGNETIC FIELDS. Sigman, D. R.; Reinmann, J. J. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Apr 1973. 16p. (NASA-TM-X-2783). NTIS.

Results of initial diagnostics on the Lewis Research Center hot-ion-plasma source (HIP-1) are reported. The mirror-contained plasma was heated by applying a radial electric field similar to that used in the ORNL burnout experiments. An electrostatic neutral-particle analyzer was used to make a parametric study of ion energy distributions in both hydrogen and deuterium plasmas. Ion temperatures as high as 2 keV were measured in plasmas with electron densities greater than $10^{12}/cm^3$. The performance of the device was found to be extremely sensitive to a magnetic field. There are indications that ion heating was reduced when the size of the Larmor orbit was larger than the region of a strong radial electric field. (auth)

9189 (SLA-73-5694) CALCULATIONS RELATING TO SELF-GENERATED MAGNETIC FIELD MEASUREMENTS IN LASER PLASMAS. Widner, M. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1973. 12p. (CONF-731009-4). Dep. NTIS $3.00.

From annual plasma physics meeting of the American Physical Society; Philadelphia, Pennsylvania, USA (31 Oct 1973).

Calculations are described that explain many qualitative features of spontaneous magnetic field measurements. Fields of 1 to 1000 G were measured in a number of reported experiments using magnetic probes. These probes are located on the order of 1 cm from the target. On the other hand, numerical simulation of laser plasmas indicates much larger magnetic fields can be produced nearer the target. The relationship between the probe measurements and the calculated large fields near the target is examined. (auth)

9190 (SLA-73-6003) RESEARCH ON THE PARAMETERS AND DYNAMICS OF LASER PLASMA. Boiko, V. A.; Krokhin, O. N.; Sklizkov, G. V. (AN SSSR, Moscow. Fizicheskij Inst.). Sep 1973. Translation of Preprint No. 121. 94p. Dep. NTIS $6.75.

Experimental research on the hot plasma of the laser flame is reviewed. The different space-time interrelationships of the laser plasma's basic parameters and their relation to the characteristics of the heating radiation are discussed. The described experiments were performed with the laser beam in sharp focus on a thick target. (172 references) (MOW)

9191 EXPERIMENTAL STUDIES ON ENERGY TRANSFER IN LASER-PRODUCED PLASMAS. Saleres, A.; Floux, F.; Cognard, D.; Bobin, J. L. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). Phys. Lett.; 45A: No. 6, 451-453(5 Nov 1973).

Investigations about total neutron fluxes and backscattered radiation from the plasma are performed. The laser power impinging onto the solid deuterium target ranges from 10 to 22 gigawatts. (auth)

Stability

9192 (CEA-CONF-2382) STABILIZING EFFECT OF AN ELECTRON TEMPERATURE GRADIENT ON COLLISIONLESS DRIFT INSTABILITIES. Brossier, P.; Deschamps, P.; Gravier, R.; Pellat, R.; Renaud, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). 1973. 4p. (CONF-730906-8). Dep. NTIS (U. S. Sales Only) $3.00.

From 11th international conference on phenomena in ionized gases; Prague, Czechoslovakia (10 Sep 1973).

Using a rf heating technique to modify the electron temperature, the influence of the temperature gradient on the collisionless drift waves was experimentally established. Under conditions where the waves can be made marginally stable, removal of the temperature gradient is observed to restore back the instability. (MOW)

9193 (TID-26472) THEORY OF DRIFT-UNIVERSAL AND DRIFT CONE MODES OF COLLISIONLESS PLASMA IN CYLINDRICAL GEOMETRY. McCrory, R. L. Jr. (Massachusetts Inst. of Tech., Cambridge (USA)). Jun 1973. Contract AT(11-1)-2168. 174p. Dep. NTIS $10.75.

Thesis.

The problem of the collisionless electrostatic drift universal and flute-like drift-cone instabilities of a hot, fully ionized plasma in a magnetic field in cylindrical geometry is considered. A discussion is given of the validity of the electrostatic approximation, and the restrictions of the electrostatic assumption on the value of β (ratio of plasma pressure to magnetic pressure). The work introduces a rigorous kinetic formulation of the radial eigenmode problem of a collisionless plasma in cylindrical geometry. The cylindrical model includes, in principle, those sources of free energy available to drive microinstabilities inherent in many plasma-confinement devices, viz., radially varying density gradients, temperature gradients and temperature anisotropies in the directions perpendicular and parallel to the magnetic lines of force, and velocity space "loss-cone"-like distribution functions common to mirror devices. Our zeroth order density distribution is a Gaussian in the radial direction. The general problems of cylindrical equilibrium in the presence of gradients in the temperature and density, and velocity-space anisotropies are considered. A singular integral equation is derived for the Hankel transform for each azimuthal component of the perturbed electrostatic potential in the plasma. The treatment includes the finite Larmor radius corrections to all orders of a_i/R (a_i is the ion Larmor radius, R the plasma radius) for those cases for which the ratio is less than

unity. The nature of the radial eigenmodes of the plasma are determined for the drift-universal and drift-cone modes of an inhomogeneous plasma without resorting to the "local" approximation often employed in the literature in solving the integro-differential dispersion equation for the perturbed potential. The results give the cylindrical marginal stability boundaries for the drift and drift-cone modes for various values of the azimuthal mode number. The cylindrical results indicate that the critical values of R/a_i necessary to stabilize the drift-cone modes are substantially lower than those previously estimated by others. In particular, the cylindrical results are applied in the parameter regime suitable to the Livermore 2X machine, and it is found that stability is predicted for values of the azimuthal mode number, l, less than 5. The results for the drift-cone modes show that the threshold frequency is relatively insensitive to a_i/R, but is quite sensitive to the ratio of the ion to electron temperature. (auth)

9194 NONLINEAR DECAY OF ION–ACOUSTIC INSTABILITY IN A CURRENT PLASMA. Perepelkin, N. F.; Suprunenko, V. A.; Vasil'ev, M. P.; Diky, A. G. (Physical-Technical Inst., Kharkov). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The probability characteristic of plasma uhf noise was obtained in the "Uragan" stellarator. Thermal and nonthermal uhf emission was detected in helium discharges. These emissions were observed in the vicinity of plasma frequencies corresponding to various density regions of the plasma column. Intensive Langmuir oscillations in the plasma were probably excited by the beam of "runaway" electrons. The x-ray emission associated with this beam was observed from a tungsten target at 7 cm from the column axis. The fluctuation spectrum of the uhf emission versus plasma parameters allows the ion-acoustic nature of the turbulent pulsations to be established. (GE)

9195 HYDROMAGNETIC STABILITY OF STELLARATORS OF SPITZER'S "FIGURE-8" TYPE AT HIGH PLASMA PRESSURE. Mikhailovskii, A. B.; Shafranov, V. D. (Inst. of Atomic Energy, Moscow). JETP Lett. (USSR) (Engl. Transl.); 18: No. 3, 124-125 (5 Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 3, 208-210(5 Aug 1973).

The hydromagnetic instability in toroidal traps of round cross section without a longitudinal current, first proposed by Spitzer, is studied. It is shown that such traps are hydromagnetically stable at plasma pressures exceeding the pressure of the effective poloidal magnetic field. (auth)

9196 CONTRIBUTION TO THE NONLINEAR THEORY OF THE MODIFIED DECAY INSTABILITY. Al'terkop, B. A.; Volokitin, A. S.; Shapiro, V. D.; Shevchenko, V. I. JETP Lett. (USSR) (Engl. Transl.); 18: No. 1, 24-26(5 Jul 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 1, 46-49(5 Jul 1973).

An expression is derived for heat flow in a plasma in which the electron mean free path exceeds the characteristic scale of the inhomogeneity. This expression is used to derive a formula for the electron temperature in a plasma corona as a function of the laser power. (auth)

9197 CYCLOTRON INSTABILITIES IN A FINITE-PRESSURE PLASMA. II. Amano, T.; Shimomura, Y.; Yamamoto, S. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 34: No. 6, 1593-1599(Jun 1973).

Cyclotron instabilities of mirror-confined plasmas are investigated without use of the electrostatic approximation. A "j = 1" anisotropy-loss-cone distribution is taken for the ion velocity distribution function and the electron is assumed cold. The analogous nonelectrostatic instability was studied. It is shown that this mode can be stabilized if cyclotron damping due to a small but finite $k_{||}$ is taken into account. (auth)

9198 MHD STABILITY OF A HIGH-BETA REVERSE FIELD PINCH. Ortolani, S. (Univ., Padua); Grossman, W. (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Using a one-dimensional time-dependent MHD code developed at Culham, reverse-field pinch profiles were computed for the parameters of the toroidal pinch experiment presently under construction at Padua. The linearized ideal equations of motion, including compressibility for the radial plasma perturbation and the exponential growth rate, are solved. The profiles correspond to various instants during the initial phase of the formation (implosion) of the reverse field pinch. More important than the actual values of the growth rate calculated is the nature of the radial eigenfunctions found for the three cases. It appears that the criterium of strictly positive Φ is a very critical condition which, if violated, can produce fast-growing disruptive plasma instabilities in reverse-field pinch configurations. (GE)

9199 INSTABILITY OF ALFVEN WAVES IN A TOROIDAL CONFIGURATION. Samain, A. (CEN, Fontenay-aux-Roses, France). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The torsional MHD Alfven waves may be driven unstable in a magnetically confined plasma by the mechanism of interchange. This instability is a reactive one in the sense that the motion of the particles along the lines of force, as well as the cyclotronic motion, remains adiabatic in the presence of the wave. It is shown that in a configuration such as a tokamak where it has been suppressed (by magnetic shear or magnetic well), torsional Alfven waves may become unstable by a Landau effect which effects the parallel motion of one class of resonant ions. The electric field of the wave, while transverse to the static magnetic field, draws energy from the particles by acting along the guiding-center velocities. (GE)

9200 EQUILIBRIUM AND STABILITY OF PLASMA DURING OHMIC HEATING IN THE URAGAN STELLARATOR. Dikii, A. G.; Kuznetzov, Yu. K.; Pavlichenko, O. S.; Samoilenko, Yu. I.; Suprunenko, V. A. (Physical-Technical Inst., Kharkov). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

In previous experiments on ohmic heating of plasma in the "Uragan" stellarator, a critical value of ohmic current was observed: when this current was more than the critical one, the particle and energy losses increased abruptly. The results of experiments are presented in which the question of whether this limitation of confinement and heating by reaching a critical value is a result of lack of equilibrium or stability of a plasma. The location of a plasma boundary was determined by electric probes and with the help of the image converter. Special distributed diagnostic magnetic windings allowed the measurement of the displacement of plasma current (m = 1, n = 0 mode) and observation of the lowest (m = 1, n = 1) mode of helical instability. Magnetic field oscillations were measured by local magnetic probes. The plasma equilibrium exists in all regimes, but for plasma currents more than the critical one, the current driven helical instability was excited. (GE)

9201 OBSERVATION OF COLLISIONLESS DRIFT WAVES IN THE JAERI HEXAPOLE. Nagashima, T.; Zrizono, S.; Yamato, H.; Ohtsuka, H.; Shiina, T.; Tamura, S.; Yoshikawa, M.; Mori, S. (Japan Atomic Energy Research Inst., Tokai). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

Low-frequency fluctuations of the drift type are observed in the JAERI toroidal hexapole. It is shown that mode transition of poloidal mode number occurs at a critical toroidal field superimposed on the hexapole field as the toroidal field is increased. A hydrogen plasma is produced by the electron resonance heating in the hexapole. The density is 2×10^{10} cm^{-3} with T(decay) = 0.8 msec and the electron temperature T_e is 0.7 eV at 0.4 msec after the heating power is turned off. The ion temperature T_i is estimated to be $\sim$ 0.1 eV. The average hexapole field is 460 G. (GE)

9202 EFFECT OF TEMPERATURE PERTURBATIONS ON ION-ACOUSTIC AND DRIFT WAVES IN A WEAKLY COLLISIONAL PLASMA. Ong, R. S. B.; Yu, M. Y. (Univ. of Michigan, Ann Arbor). Plasma Phys.; 15: No. 7, 659-668(Jul 1973).

The influence of temperature perturbations on the propagation and stability of low-frequency waves in a weakly collisional plasma is analyzed. Temperature oscillations, in general, reduce the stability of ion acoustic waves. They also tend to lower the magnitude of the critical current necessary for triggering the instability. In the case of drift waves, the effect is to change the destabilizing role of electron–ion collisions in the isothermal model into a damping influence. (auth)

9203 ELECTROMAGNETIC INSTABILITIES OF FINITE-PRESSURE ANISOTROPIC PLASMA WITH HOT ELECTRONS. Stepanov, K. N.; Yegorenkov, V. D. (Physical-Technical Inst., Kharkov). Plasma Phys.; 15: No. 7, 627-634(Jul 1973).

Instabilities of finite-pressure plasma with hot electrons and cold ions are considered, the instabilities being driven by the electron-pressure anisotropy in the presence of the loss cone. The electromagnetic waves, which correspond in isotropic plasma to whistler and ion acoustic waves (fast magnetosonic wave and slow ordinary wave), appear to be unstable. These instabilities are aperiodic and their growth rates are considerably higher than the ion-cyclotron frequency and considerably below the electron cyclotron frequency. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 8254, 8255, 8346–8348, 8358, and 8366.

9204 (AREAEE-169) TOPOGRAPHY OF THE MAGNETIC FIELDS AND PLASMA CURRENTS IN A THETA PINCH WITH AN AZIMUTHAL MAGNETIC FIELD. El-Khalafawy, T. A.; Youssef, A. M.; Diatlov, V. G. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

In θ-pinch discharge with an azimuthal magnetic field, the closed toroidal magnetic surface similar to tokamaks exist during about 5 μsec. The observed macroscopic deformations of the plasma annulus can be stabilized by applying a sufficiently high azimuthal magnetic field. The reason of disruption of the closed magnetic configuration and plasma losses can be the conventional instability which appears at the outer regions of the plasma annulus where the Suydam criterion is violated. (auth)

9205 (CEA-CONF-2434) FONTENAY-AUX-ROSES TOKAMAK (TFR) AND THE STEPS TOWARD A THERMONUCLEAR REACTOR. Rebut, P. H. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). [nd]. 32p. (In French). (CONF-730574-7). Dep. NTIS (U. S. Sales Only) $3.75.

From congress on the centenary of the French Physics Society; Vittel, France (28 May 1973).

The properties of the Tokamak magnetic configuration are recalled. The role of the poloidal field associated with the plasma current is emphasized. The main characteristics of the TFR device are summarized (plasma radius = 20 cm; torus major radius = 98 cm; plasma current = 400 kA; toroidal field 60 kG). The first results are presented (plasma current = 200 kA during 0.25 s, with a toroidal field of 40 kG). The major problems to be solved for an ignition experiment are outlined, with emphasis on the impurity content of the plasma. (FR)

9206 (CONF-731101-32) MATERIALS PROBLEMS IN THE DESIGN OF MAGNETICALLY CONFINED PLASMA FUSION REACTOR. Fraas, A. P. (Oak Ridge National Lab., Tenn. (USA)). 1973. 23p. Dep. NTIS $3.25.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Materials engineering problems are discussed for the following areas: superconducting magnets, tritium breeding, structural materials, radiation damage, electrical insulating materials, tritium problems, hydrogen diffusion barrier, remote fabrication, thermal insulation, and magnet shield. (MOW)

9207 (CONF-731114-2) ANALYSIS OF THE 50-kG TOROIDAL FIELD COIL FOR HIGH-FIELD ORMAK. Gauster, W. F.; Walstrom, P. L. (Oak Ridge National Lab., Tenn. (USA)). 1973. 13p. Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Due to space limitations on the windings, the power efficiencies of toroidal field coils for tokamak experiments are in general rather poor. Very substantial improvement can be achieved by using asymmetrical magnet coil designs. The results of mathematical analysis and electric-current-flow plotting for various types of asymmetrical coil designs are discussed, and numerical data of resistance measurements with the High-Field ORMAK prototype coil are given. (auth)

9208 (CONF-731114-11) DEVELOPMENT, FABRICATION, AND ASSEMBLY OF A THIN-WALL, LOW-ASPECT-RATIO LINER AND THE ENCLOSED TUNGSTEN LIMITER FOR ORMAK. DeCamp, S. M. Jr.; Rylander, J. D. (Oak Ridge National Lab., Tenn. (USA)). [nd]. 9p. Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The regime in which a Tokamak operates depends largely on the amount of impurities present. To keep the plasma as pure as possible, the plasma region is surrounded by a thin but vacuum-tight stainless steel liner. The ORMAK liner is a stainless steel torus having a major radius of $31\frac{1}{16}$ inches and a minor radius of $9\frac{7}{8}$ inches. Wall thickness of the liner is 10 mils. The liner consists of 26 sections welded together to form two halves plus two special sections. These special sections contain the limiter and laser ports. The two special sections are also used to make the final closure of the liner after it has been placed inside the aluminum torus. The liner contains 53 diagnostic ports and 4 injection beam ports. (auth)

9209 (CONF-731114-12) CONCEPTUAL DESIGN STUDY FOR THE ORMAK-F/BX FACILITY. Haubenreich, P. N.; Cannon, D. D.; Fraas, A. P.; Lord, R. S.; Roberts, M. (Oak Ridge National Lab., Tenn. (USA)). 1973. 12p. Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Consideration is being given in the U. S. to a large, injection-heated tokamak that could attain the zero-power Lawson criterion with H plasma in the late 1970's. The facility would be designed for subsequent replacement of some internal components and addition of shielding and containment to permit D–T burning experiments. An 8-manyear conceptual design study is to be accomplished in FY-1974 at Oak Ridge; this project is called ORMAK-F/BX for Oak Ridge Tokamak Feasibility and Burning Experiments. The F/BX reference design is now evolving. Conservative projections of plasma behavior indicate that the toroidal field coils must be about 5-meter bore diameter. Superconducting NbTi has been chosen for the TF coil windings and the plasma driving system will use an iron core and return yokes. (auth)

9210 (CONF-731114-13) ANALYSIS OF TRITIUM DISTRIBUTION AND LEAKAGE CHARACTERISTICS FOR TWO FUSION REACTOR REFERENCE DESIGNS. Maroni, V. A. (Argonne National Lab., Ill. (USA)). 1973. 7p. Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Results of analyses of the tritium distribution and leakage characteristics for two current fusion power reactor designs—the Princeton Reference Model Tokamak and the LASL/ANL Reference Theta Pinch Reactor—are presented and compared. The philosophy of the model used in these analyses is discussed, and the computer code, developed to carry out the calculations, is described. Consideration is given to the practical aspects of those design features which have the greatest influence on tritium inventories and leakage rates; i.e., (1) the blanket and fuel processing systems, (2) the protective atmospheres, and (3) the application of some special materials as tritium barriers. The results of these analyses have permitted several interesting comparisons to be made between a molten salt–stainless steel reactor design (the Princeton Tokamak model) and a liquid lithium–refractory metal reactor design (the LASL/ANL Theta-Pinch model). (auth)

9211 (CONF-731114-15) DESIGN OF HIGH POWER INJECTION HEATERS FOR THE ORMAK SYSTEM. Stewart, L. D.; Davis, R. C.; Ezell, J. C.; Jernigan, T. C.; Morgan, O. B.; Stirling, W. L.; Wright, R. E. (Oak Ridge National Lab., Tenn. (USA)). 1973. 7p. Dep. NTIS $3.00.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The development of neutral injectors at ORNL has stressed input power levels sufficient to heat plasma ions. It has also stressed other problems equally important for success in neutral-injection heating. Injection pulse lengths, which have been extended to 200 msec, will need to be extended further for tokamaks of the future. This requires the ORNL approach of energy efficiency, cooled ion sources, and dc supplies. Low beam impurity content requires high duty-cycle cleanup, which again means energy efficiency, cooled sources, and dc supplies. Design of the injectors to have gas efficiency and to have sufficient auxiliary pumping is necessary to keep cold gas streaming down to levels not expected to perturb the tokamak plasma. (auth)

9212 (CONF-731114-16) ENGINEERING CONSIDERATIONS OF THE DUOPIGATRON ION SOURCE. Davis, R. C.; Jernigan, T. C.; Morgan, O. B.; Stewart, L. D.; Stirling, W. L. (Oak Ridge National Lab., Tenn. (USA)). 1973. 6p. Dep. NTIS $3.00.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

In developing an injector system at ORNL with capabilities necessary for high-power injection into ORMAK, several engineering problems must be solved. Emphasis is given to the design and fabrication of the system to achieve electrical stability, power dissipation, beam optics, beam quality, high efficiency and reliability. (auth)

9213 (CONF-731114-18) INFLUENCE OF THE BETWEEN-THE-TURNS THERMAL INSULATION ON THE DUTY OF A LARGE, LIQUID-COOLED PULSED COIL. Derby, R. W. (Oak Ridge National Lab., Tenn. (USA)). 1973. 10p. Dep. NTIS $3.00.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The moving cold front set up by good thermal insulation between the coil turns efficiently sweeps the heat from the conductor. A quantitative description of this effect is given. The toroidal field coils of the ORMAK machines are used as an example, but the

discussion is applicable to any liquid-cooled coil made from hollow conductors. (MOW)

9214 (CONF-731114-20) PASSIVATION OF THE ORMAK VACUUM LINER. Simpkins, J. E. (Oak Ridge National Lab., Tenn. (USA)). 1973. 12p. Dep. NTIS $3.00.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The inner vacuum liner in ORMAK, which was constructed of type 304L stainless steel, has been coated with a 1- to 2-micron gold film. The resultant surface is considerably more inert than the bare stainless surface and reduces plasma–wall interactions. It was found that some of the constituents of the stainless steel diffuse through the gold film when the couple is heated to ~ 300°C. Further investigation indicated that a 500 Å platinum field between the gold and stainless acts as a diffusion barrier for many of these constituents. Diffusion profiles of oxygen, silicon, sulfur, and carbon suggest that platinum acts as a barrier to prevent diffusion of all these elements. Mass scans of the gold surface with platinum underlayer show greatly reduced peaks for most of the impurities found on the bare stainless surface. (10 figures) (auth)

9215 (CONF-731114-21) CONCEPTUAL DESIGN OF A THETA PINCH POWER PLANT. Coultas, T. A.; Dauzvardis, P. V.; Krakowski, R. A. (Argonne National Lab., Ill. (USA)). 1973. 11p. Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

An engineering design of a conceptual CTR power plant is presented. The fusion reaction is produced in a plasma in a toroidal chamber having major and minor radii of 55 and 0.5 meters, respectively. Major systems discussed include: implosion heating, compression/confinement, energy storage, first wall, blanket, fuel/ash supply and removal, power conversion, and others, with emphasis on the engineering systems. (auth)

9216 (CONF-731114-117) THREE-DIMENSIONAL MECHANICAL STRESSES IN TOROIDAL MAGNETS FOR CONTROLLED THERMONUCLEAR REACTORS. DeMichele, D. W.; Darby, J. B. Jr. (Argonne National Lab., Ill. (USA)). 1973. 29p. Dep. NTIS $3.50.

From fifth symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

It appears that, when considering the field limits of toroidal superconducting magnets, the mechanical stresses on the coils will be a primary limitation. The results of a detailed analysis of the forces and resultant stresses imposed on the magnet coils are presented. Two coil geometries have been analyzed; the circular coil toroid similar to the Oak Ridge design, and the "D"-shaped coil similar to the design proposed by the Princeton Plasma Physics Laboratory. Stresses calculated by a three-dimensional analysis are presented for the coils under normal and abnormal operating conditions. The abnormal condition considered is the unexpected "quench" of an adjacent coil resulting in asymmetric magnetic fields. The three-dimensional magnetic fields, within the current-carrying conductors, were calculated to determine the body forces. A three-dimensional, finite-element elastic stress analysis code, "SOLID SAP", was used to evaluate the resultant mechanical stresses. (23 figures) (auth)

9217 (GULF-GA-A-12789) FUSION TECHNOLOGY. Summary Progress Report, October 1, 1972–September 30, 1973. Hopkins, G. R. (Gulf General Atomic Co., San Diego, Calif. (USA)). 1 Oct 1973. Contract AT(04-3)-167. 19p. Dep. NTIS $4.00.

A study of pressurized-helium cooling for a fusion reactor blanket–first wall assembly composed of molten liquid lithium with stainless steel structure was conducted. The University of Wisconsin Tokamak fusion reactor design, employing flowing lithium as coolant, was used as the starting point. Helium cooling is conceptually accomplished by considering the lithium as static and distributing small diameter stainless steel tubing, containing flowing pressurized helium as coolant within the molten lithium blanket region in sufficient numbers to remove the heat generated. A 14-MeV neutron energy flux of 1.25 MW/m^2 and an x-ray energy flux of 0.25 MW/m^2 were considered as the primary plasma energy sources. A parametric study for 50- and 70-atm helium pressures and 500 and 650°C stainless steel upper temperature limits was considered. The results show that reasonable pumping powers for the circulating helium, ranging from 0.8 to 12% of the thermal power may be achieved. The additional blanket volume required for the helium space ranges from 1.2 to 1.7%, and the stainless steel volume increase for the tubing ranges from 0.5 to 1.0%. The increase in metal fraction in the blanket decreases the tritium breeding only slightly, from 1.49 to 1.46 for the 1% additional stainless steel case. Thus, these volume increases for incorporation of helium cooling do not appear to change the overall characteristics of the blanket system appreciably and an adequate margin exists for more optimization of the system. Some attendant advantages for helium cooling are: intermediate heat exchange loops may be eliminated; lithium inventories and hence tritium and radioactive corrosion product inventories may be reduced; and higher exit temperatures may be achievable, resulting in increases in plant thermodynamic efficiencies. (auth)

9218 (LA-5380-MS) RELATIVISTIC ELECTRON PINCH THERMONUCLEAR DEVICE. Mills, C. B. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Nov 1973. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

A novel plasma pinch device that produces a relatively large nanosecond burst of neutrons and fully stripped ions is being developed at the University of California (Livermore and Berkeley). The electrical efficiency for the burst is in the percent range, and there is evidence that nuclear burn is occurring in the pinch. The device appears to operate like an imploding ion beam, with MeV ion temperatures, using the Bennett pinch as a virtual electrode. Reactions observed in a C^{6+}, D^+ plasma produce 10^{11} (D, D) neutrons, and a jet of 10^{14} almost monochromatic ions, many of which are C^{6+}. H^+ and D^+ at 30 MeV from a 2- to 5-MeV electrode potential, show that a collective acceleration process must be invoked. (auth)

9219 (LA-5434-MS) SCALING LAWS FOR THE LINEAR THETA PINCH: A COMPARISON OF MAGNETIC AND LASER HEATING. Ellis, W. R.; Sawyer, G. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 23p. Dep. NTIS $4.00.

The scaling laws for a linear theta-pinch reactor are developed. Conventional magnetic heating and laser heating of the plasma are compared. It is shown that, if a confining magnetic field of 400 kG is used, a power producing reactor need be only 1.2 km long. (32 references) (auth)

9220 (LA-UR-73-1576) INDUCTIVE ENERGY STORAGE SYSTEM WITH CAPACITIVE OR HOMOPOLAR TRANSFER. Thomassen, K. I. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 15p. (CONF-731114-8). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

A capacitive energy transfer scheme is discussed that is capable of meeting the requirements of theta-pinch systems through the D–T burning experiments. The idea can be scaled to reactor size using inertial storage elements such as the homopolar disk or drum to provide the storage of energy during the transfer process. (MOW)

9221 (MATT-1005) ION AND FAST NEUTRAL BOMBARDMENT OF SURFACES IN CONTROLLED FUSION DEVICES. Perkins, H. K. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Oct 1973. Contract AT(11-1)-3073. 33p. Dep. NTIS $3.75.

The erosion of ferrous- and nickel-alloy walls in fusion reactors from impinging, energetic D, T, He, and Ar ions and neutrals is discussed. The two major machanisms of erosion are sputtering and blistering. Pertinent data are reviewed to obtain estimated or experimental sputtering yields in the energy range 100 eV to 10 keV. The sputtering coefficients for Ar, He, and T are roughly 10^2, 10, and 1.5 times the value for D (at the same energy). Erosion from blistering is unimportant for Ar, unexamined for D or T, and probably comparable to sputtering for ~10-keV He. (auth)

9222 (ORNL-TM-4371) MECHANICAL ENGINEERING DESIGN CONSIDERATIONS FOR A TOKAMAK SCIENTIFIC FEASIBILITY EXPERIMENT AND PLASMA TEST REACTOR. Fraas, A. P.; Tudor, J. J. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 54p. Dep. NTIS $4.75.

A substantial fraction of the cost of both the design and the construction of the system will be dependent on the structure of the experiment itself, the auxiliary equipment required, and the building in which it is installed. This memo is intended to indicate how some of these problems might be handled, what the equipment might look like, and what its cost might be. The effects of a number of different design choices for major components are given particular attention. (auth)

9223 (UCID-16360) EFFECT OF COMPONENT PERFORMANCE PERTURBATIONS ON NEUTRAL BEAM INJECTION SYSTEM PERFORMANCE IN THERMONUCLEAR REACTORS. Hovingh, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 3 Oct 1973. Contract W-7405-eng-48. 46p. Dep. NTIS $4.50.

The effect of component performance perturbations on the efficiency of injection of neutral beams into thermonuclear reactors is discussed for a specific type of a neutral-beam injector. Based

on the model chosen, which includes using direct conversion of the unneutralized portions of the ion beam and recovery of the losses from each element of the injector system, quantitative effects of component performance perturbations are presented as a function of the injected-deuterium-atom energy, using positive and negative deuterium ions. The component performances having the largest leverage on the system efficiency are, in decreasing order, the accelerator efficiency, the trapping fraction, the neutralizer loss direct conversion, and the neutralizer power efficiency. (27 figures) (auth)

9224 (UCRL-75135) EFFECT OF COMPONENT PERFORMANCE PERTURBATIONS ON THE EFFICIENCY OF INJECTION OF NEUTRAL BEAMS INTO THERMONUCLEAR REACTORS. Hovingh, J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Oct 1973. 7p. (CONF-731114-4). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

The effect of component performance perturbations on the efficiency of injection of neutral beams into thermonuclear reactors is discussed for a specific type of a neutral beam injector. Based on the model chosen, which includes using direct conversion of the unneutralized portions of the ion beam and recovery of the losses from each element of the injector system, quantitative effects of component performance perturbations are presented as a function of the injected deuterium atom energy, using positive and negative deuterium ions. The component performances having the largest leverage on the system efficiency are, in decreasing order, the accelerator efficiency, the trapping fraction, the neutralizer loss direct conversion, and the neutralizer power efficiency. (auth)

9225 (UCRL-75146) FLAT-TOPPING POWER SUPPLY FOR THE 2XIIB CONTAINMENT MAGNET. Smith, B. H.; Reginato, L. L.; Robinson, J. W.; Dexter, W. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 12 Oct 1973. 6p. (CONF-731114-6). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

Power supplies are being developed to maintain a current constant at the peak value in containment magnet coils for a period of 20 msec. Each power supply consists of a bank of electrolytic capacitors which is divided into 20 sections. All sections are charged initially to the appropriate voltage and then discharged sequentially at 1 msec intervals until their energy is expended. The design considerations of these power supplies and the transmission and load systems are discussed. (auth)

9226 (UCRL-75169) ELECTRICAL ASPECTS OF THE LIVERMORE 2XIIB CONTAINMENT MAGNET AND ASSOCIATED EQUIPMENT. Vogtlin, G. E.; Bulmer, R. H.; Robinson, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1973. 6p. (CONF-731114-9). Dep. NTIS $3.00.

From 5th symposium on engineering problems of fusion research; Princeton, New Jersey, USA (6 Nov 1973).

In order to extend the present understanding of mirror containment, the 2XII experiment is being extensively modified. The new experiment, designated 2XIIB, includes new minimum-B containment coils, a new gate coil, a new vacuum chamber, and miscellaneous other components. The existing capacitor banks are being modified for higher-voltage operation to decrease the risetime of the magnetic field. The electrical considerations involved in this program are described. (auth)

9227 FUSION REACTORS. Schwarz, K.; Bernhauer, W. Energ. Tech.; 25: No. 9, 229-231(1973). (In German).

A short survey is presented of the principles of fusion reactions and the technical approaches used up to now (e.g., plasma heating and confinement by magnetic fields in the stellarator or tokamak configuration, laser-induced plasmas). A few remarks are added concerning the time of implementation, size, and economics of fusion power plants. (GE)

9228 DESIGN OF A TOKAMAK DEVICE WITH AN AXISYMMETRIC DIVERTOR (DIVA). Kitsunezaki, A.; Maeda, H.; Shimomura, Y.; Yoshikawa, M. (Japan Atomic Energy Research Inst., Tokai). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The objective of the experiment is to study plasma confinement in tokamaks with a noncircular cross section which possess higher stability properties than tokamaks with a circular cross section and to investigate the operation of an axisymmetric divertor and its effect on plasma confinement. A teardrop-like cross section is chosen which provides a deep magnetic well and a large magnetic shear. Evaluation of pumping capability of the divertor was made by Monte-Carlo calculation and gave the following results: (1) sticking probability and backscattering ratio of hydrogen ions are good enough to provide adequate pumping; (2) hydrogen gas should be admitted into the chamber by fast-acting valves to keep titanium surfaces fresh before the plasma is produced; (3) sputtering of titanium by hydrogen ions is insignificant; and (4) most uncertain is gas desorption of methane from the titanium surfaces on arrival of hydrogen. (GE)

9229 DESCRIPTION OF SPICA. Bobeldijk, C.; van Heinjningen, R. J. J.; van der Laan, P. C. T. (FOM-Institut voor Plasma-Fysica, Jutphaas, Netherlands). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

A description is given of a Screw Pinch Confinement Apparatus with radii R = 60 cm, r = 20 cm. SPICA is designed to study the long-term stability of screw pinches with temperatures in the order of 300 eV, surrounded by a current-carrying low-density plasma. Two regimes will be studied in SPICA. The first is that for when the current is below the Kruskal limit. In the second regime, the current is approximately 4/3 times the Kruskal current. Here m = 1 stability is expected, due to the force-free currents. It is not known whether these stabilizing currents will persist during longer times in screw pinches with a hot central core. (GE)

9230 RECYCLING AND MAGNETIC FIELD RIPPLE INFLUENCES ON THE TFR PLASMA HEATING BY FAST NEUTRAL INJECTION. Girard, J. P.; Khelladi, M.; Marty, D. A. (CEN, Fontenay-aux-Roses, France). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

A three-dimensional recycling model is included in a numerical code. The cold neutral population present in the plasma is calculated self-consistently. An isotropic flux of cold H_2^0 due to diffusing particles, charge-exchanged particles, and noncaptured beam fraction, all reaching the wall, is ionized at the plasma edge and undergoes dissociation, yielding an H^0 population of mean energy (2 eV). These H^0 are either ionized or charge-exchanged, thus giving a second generation of hotter neutrals that could go deeper inside the plasma. These phenomena affect the mass and energy balances. Ripple in toroidal field strength (6% at the boundary of T.F.R. plasma) causes nonsymmetric trapping of particles. The resulting drift orbits go to the wall. So diffusion and ion heat conduction are increased above the neoclassical values if the collision frequency is low enough. (GE)

9231 NUMERICAL SOLUTION OF MHD EQUILIBRIUM WITH AXISYMMETRY. von Hagenow, K.; Lackner, K. (Max Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1973). vp.

From 3rd international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

The application of two basically different programs for determining diffuse axisymmetric equilibria in the Belt Pinch experiment at Garching is discussed. In the first program, the plasma is enclosed by a perfectly conducting torus with rectangular cross section; in the second, the external field is determined by prescribing currents in given conductors. An iteration procedure that allows the height of the plasma column to be chosen arbitrarily is described. The flux enclosed by the plasma and the radial compression are practically independent of the height in a wide range and agree very well with a simple infinite-height model. Configurations with practically arbitrary ellipticity can be found for diffuse equilibria. The radial compression can, to a certain extent, be controlled by a "skin distribution," but higher compressions than 2, as observed experimentally, will probably require force-free fields instead of vacuum outside the plasma. (GE)

9232 ELECTRODE HEAT DISSIPATION LIMITS ON MULTI-APERTURE ION SOURCE PERFORMANCE. Cole, H. C.; Hammond, D. P.; Jones, E. M.; Riviere, A. C.; Sheffield, J. (United Kingdom Atomic Energy Authority Research Group, Abingdon, Eng.). Rev. Sci. Instrum.; 44: No. 8, 1024-1028 (Aug 1973).

The dissipation of heat in the electrodes of multi-aperture ion sources is a major factor in limiting the power output and beam-pulse duration. The results of a series of tests on multi-aperture and single-aperture arrays are used as the basis for the derivation of formulas which define the limits of the practical operating regime for a single edge-cooled electrode element. (auth)

9233 MAGNETIC, EQUIPOTENTIAL, AND ISOBARIC SURFACES IN TOR-2 STELLARATORS. Popov, S. N. (Inst. of Physics, Moscow). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

It is shown that the equipotentials coincide with B surfaces with an accuracy of several per cent of T(e), while the n surfaces are

shifted outside the toroid. An l = 2 magnetic field is created by a system of separate elliptical coils. The number of the field periods is 16. The large radius of the toroid is R = 63 cm, the small radius of the vacuum chamber 3.6 cm. The magnetic field at τ = 0.08 reached 22 kG and at τ = 1 reached 8 kG. The plasma was injected from an outside spark source. The measurements of the B-, n-, and ϕ-surfaces were carried out by a double-probe method. (GE)

9234 1-MJ BELT PINCH EXPERIMENT IN GARCHING. Wilhelm, R.; Zwicker, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

A new experiment has been planned for higher temperatures at increased plasma dimensions. This should allow studies of stability and diffusion for times longer than 100 μsec. In the first stage of the experiment the investigation is restricted to the collision-dominated regime at temperatures of 50 to 100 eV. In the second stage, the transition into the collisionless regime is expected at temperatures of 200 to 500 eV. Preionization in the new device is a special problem. Using a large transmission line filled with large transformer iron cores, a decoupling of the preionizer bank from the main bank is achieved during the rise time of the magnetic field. (GE)

9235 MAGNETIC FIELD PROPERTIES OF A STELLARATOR WITH ELLIPTICAL COILS. Petrenko, Yu. N.; Popryadukhin, A. P. (Inst. of Physics, Moscow). (1973). vp.

From third international symposium on toroidal plasma confinement; Garching, Germany (26 Mar 1973).

A system of discrete coils with elliptical profile instead of the traditional helical winding was applied to the stellarator TOR-2. Along with the obvious advantages of simplicity, ease of construction, and possibility to change the number of steps of the coils, the given system has a number of disadvantages in comparison with traditional systems (ineffective use of the magnetic field volume)(the need for a counterfield to increase the shear and rotational transform angle). But two improvements are possible, e.g., the use of a vacuum chamber with elliptical cross section instead of circular cross section; in principle, it is then possible to use the entire cross section of the elliptical coil. Computer calculations of the magnetic aperture and also of peculiarities in the magnetic field structure of the system with elliptical coils were performed for various steps. (GE)

9236 FUSION REACTIONS IN A PLASMA CREATED BY THE SECOND HARMONIC OF A Nd GLASS LASER. Carion, A.; Lancelot, J.; de Metz, J.; Saleres, A. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France). Phys. Lett.; 45A: No. 6, 439-440(5 Nov 1973).

About 10^3 neutrons are observed for two locations of the focus with respect to the surface of D_2 ice. A maximum 10% reflectivity is obtained for an intermediate position. (auth)

9237 APPARATUS FOR PRODUCING CONTROLLED NUCLEAR FUSIONS IN AN OPEN REACTION CHAMBER. Bastian, C. (to Euratom). Luxemburgian Patent 65,432. 29 May 1972. (In German).

Available from the Commission of European Communities, Luxenbourg.

Apparatus is described for producing controlled nuclear fusion in an open reaction chamber with an inlet for the thermonuclear fuel at one end and an outlet at the opposite end. The reaction chamber has at least three identical electrical windings spaced apart symmetrically in the circumferential direction, permitting the kinetic energy of the emerging particles to be recovered in a suitable form and to be utilized as injection and heating energy for the incoming plasma. (EU)

9238 DEVICE FOR HEATING AND STABILIZING A TOROIDAL PLASMA. Minardi, E.; Ornstein, L. T. M.; Rem, J.; Schram, D. C. Luxemburgian Patent 63,600. 23 Jul 1971. (In German).

Available from the Commission of European Communities, Luxembourg.

In a tokamak plasma device, a toroidal electric field is produced at the final stage of the ohmic heating, the frequency of which is equal to the bounce frequency of the particles trapped in the small banana orbits. As a consequence of the resonant interaction, the trapped particles increase their energy and the size of their banana orbits. On the one hand, the untrapped particles are brought to a higher energy by collisions with the trapped particles; on the other hand, the trapped particles are shifted towards regions more favorable for stability. In this way, heating and stabilization of the plasma can be reached. (EU)

9239 CERTAIN CONSIDERATIONS CONCERNING THE THERMONUCLEAR POSSIBILITIES OF A ZETA PINCH. Kvartskhava, I. F.; Matveev, Yu. V. JETP Lett. (USSR) (Engl. Transl.); 18: No. 1, 12-14(5 Jul 1973).

Translation of Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 1, 24-27(5 Jul 1973).

Some ideas are presented on the optimization of the reconciliation of the boundary and initial conditions of a pinch discharge with its self-organization to improve the possibility of stable forced evolution of the system towards a thermonuclear state. (MOW)

Wave Phenomena

Refer also to abstract 9202.

9240 (N-73-22663) APPROXIMATIONS TO THE PLASMA DISPERSION FUNCTION. Brinca, A. L. (Stanford Univ., Calif. (USA). Inst. for Plasma Research). Dec 1972. 30p. (NASA-CR-131496; SU-IPR-500). NTIS.

Linear wave propagation in hot collisionless plasmas is described by the linearized Vlasov and Maxwell equations. In uniform media, the utilization of spatial and temporal transforms of those equations leads to the consideration of integrals of the Hilbert transform type. Analysis and comparison of two simple approximations are provided based on the utilization of resonance velocity distributions. Application is then made to the Landau and whistler

9241 MODIFICATION OF WEAK TURBULENCE THEORY DUE TO PERTURBED ORBIT EFFECTS. I. General Formulation. Mima, K. (Kyoto Univ.). J. Phys. Soc. Jap.; 34: No. 6, 1620-1632(Jun 1973).

A new formulation is presented to derive a wave-kinetic equation for the spectral function of the fluctuation potential in a weakly turbulent plasma. The theory takes into account both the orbit-modification effect due to strong wave-particle resonant interactions and the wave-scattering effect usually considered in the weak turbulence theory. The effect of a uniform external electric field is also taken into consideration. The method consists in a systematic use of a diagram technique in order to collect secular-term contributions. The modified propagator generalized over the previous version by Dupree and Weinstock and the wave-kinetic equation consistent with the usual weak turbulence theory are obtained. (auth)

9242 UNIDIRECTIONAL ENERGY TRANSFER IN NONLINEAR WAVE–WAVE INTERACTIONS. Wang, P. K. C. (Univ. of California, Los Angeles). J. Math. Phys. (N. Y.); 14: No. 7, 911-915 (Jul 1973).

The wave-energy transfer in a system of three nonlinearly interacting waves is studied. Sufficient conditions for the unidirectional transfer of energy into any wave from the remaining waves and bounds for the wave amplitudes are established. Also, a relation governing the rates of energy transfer between the waves is derived. The results are applied to a magnetized plasma with three nonlinearly interacting waves. (auth)

9243 NONLINEAR WAVE MODULATION IN A PLANE-BOUNDED PLASMA. Van Dam, J. W. (Nagoya Univ., Japan). J. Phys. Soc. Jap.; 34: No. 6, 1633-1640(Jun 1973).

The extension to two dimensions of the reductive perturbation method developed by Taniuti et al. is first discussed and then applied to the problem of electromagnetic waves propagating in a cold electron plasma bounded by two conducting planes. The behavior of the amplitude modulation is found to be governed by a nonlinear Schroedinger equation, from which the stability of the wave can be determined in some limiting cases. (auth)

9244 SCATTERING OF RADIOWAVES FROM A PLASMA ELLIPSOID WITH VARIABLE PLASMA CONCENTRATION. Tyzhnenko, A. G.; Khizhnyak, N. A. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 18: No. 1, 17-22(Jan 1973).

Translated from Radiotekh. Elektron.; 18: No. 1, 19-25(Jan 1973).

The nonstationary problem of scattering of electromagnetic waves from a plasma body of ellipsoidal geometry is solved by reducing Maxwell's equations to an integral form. The relation between the electric field intensity and induction is determined from the equations of motion in an explicit integral form. The interior and exterior scattering problems are solved in the zero order approximation of Rayleigh expansion. Characteristic growing and damping oscillations of the ellipsoid are present in the scattered field; the frequencies and the increments of these oscillations are governed by its geometry. (auth)

9245 NEW MEASUREMENTS ON PARAMETRIC EXCITATION OF ION-ACOUSTIC WAVES AND HARMONICS GENERATION IN A LASER-CREATED PLASMA. Decroisette, M.;

Meyer, B.; Vitel, Y. (Centre d'Etudes de Limeil, Villeneuve-Saint Georges, France). Phys. Lett.; 45A: No. 6, 443-444 (5 Nov 1973).

Using a narrowed spectrum Nd^{3+} glass laser, it is shown that besides parametric excitation of ion-acoustic waves, another different mechanism contributes at the same time to the second harmonic line generation in a laser-created plasma. (auth)

9246 CONTRIBUTION TO THE NONLINEAR THEORY OF INDUCED SCATTERING OF A MONOCHROMATIC WAVE IN A PLASMA. Litvak, A. G.; Petrukhina, V. I.; Trakhtengerts, V. Yu. JETP Lett. (USSR) (Engl. Transl.); 18: No. 3, 111-114(5 Aug 1973).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 18: No. 3, 190-193(5 Aug 1973).

An investigation was made of the nonlinear stage of hydrodynamic scattering of a monochromatic wave. The instability due to induced scattering can be saturated by two effects: phase mixing of the particles trapped in the potential well of the electric field of the beats, and changes in the phase velocity of the beats, which cause the particles to shift from the decelerating to the accelerating phase of the field. A two-mode regime is considered in which two quasi-sinusoidal waves take part in the interaction, one the initial wave, and the other corresponding, for example, to the wave having the maximum increment. The system of equations and their solutions are described. (MOW)

9247 WAKE PAST AN OBSTACLE IN A MAGNETIZED PLASMA FLOW. Schmitt, J. P. M. (Ecole Polytechnique, Paris). Plasma Phys.; 15: No. 7, 677-690(Jul 1973).

The motion of a satellite in a collisionless plasma, parallel to the magnetic field, is simulated in a Q machine. Previous theories are extended to include the effects of a parallel ion temperature and of the self-consistent electric field. The measurements appear to be well explained by the present theory; in particular, the coupling of the wake with ionic Bernstein modes is demonstrated. When the cross-sectional area of the obstacle is made to vary in time, the propagation of a "magneto ballistic pseudo wave", the properties of which are connected to those of the steady wake, is predicted and observed. This experiment is used as a measurement of the ion mean velocity and of the ion perpendicular temperature in a Q machine. (auth)

9248 WAVE PROPAGATION IN DRIFTING WARM PLASMA UNDER GRAD'S THIRTEEN-MOMENT APPROXIMATION. Talekar, V. L.; Rawat, S. S. (Malaviya Regional Engineering Coll., Jaipur, India). Plasma Phys.; 15: No. 8, 795-805(Aug 1973).

The effects of streaming, viscous drag and heat conduction on electromagnetic and electro-acoustic waves travelling in a warm drifting plasma are studied, using an approximation based on the relaxation model for collisions. The general dispersion relations for these waves are deduced, and particular cases of non-streaming, transverse, and longitudinal-streaming plasma are discussed in detail. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstract 8944.

9249 (JPRS-59702) SPACE BIOLOGY AND MEDICINE, VOL. 7, NO. 3, 1973. Translation of Kosm. Biol. Med.; 7: No. 3, 3-90(1973). 139p. NTIS.

The report contains articles concerning the selection and training of cosmonauts; evaluation and analysis of accumulated data to facilitate the on-going transition from orbital to interplanetary flights; research aimed at guaranteeing safety on long flights and reliability of the human component of the "man-spaceship" system; space psychology and physiology; environmental problems and control (spacecraft habitability, effects of radiation and weightlessness, etc.) and telemetry. Separate abstracts are prepared for two articles. (auth)

For abstracts of individual papers see: 7994 and 9250.

9250 (JPRS-59702, pp 42-47) INFLUENCE OF THE DISCONTINUITY BETWEEN TWO MEDIA ON THE DISTRIBUTION OF ABSORBED ENERGY IN A CHARGED PARTICLE TRACK. Kudryashov, E. I.; Marennyi, A. M.; Meshcheryakova, O. M.; Popov, V. I. 1973. Translated from Kosm. Biol. Med.; 7: No. 3, 30-34 (1973).

In Space Biology and Medicine, Vol. 7, No. 3, 1973.

The influence of a vacuum-tissue interface on the radial distribution of absorbed energy in the track of a heavy charged particle was investigated. The interface effect was analyzed with respect to the relationship between the absorbed energy and the depth of particle penetration for different distances from the track axis. The computation results given in graphic form make it possible to determine the dose decrease under the influence of the vacuum-tissue interface on irradiation of thin layers of biosamples with 1 to 500 MeV/nucleon charged particles. (auth)

9251 (RD/B/N-2763) BETA: A COMPUTER PROGRAM FOR CALCULATING β-DOSE RATES FROM POINT AND PLANE SOURCES. Bailey, M. R. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Aug 1973. 43p. Dep. NTIS (U. S. Sales Only) $4.25.

A computer program has been written to calculate the beta dose rate at various distances from a point source, or along the axis of a disc source, containing a mixture of beta-emitters. Data for 75 radionuclides published recently by Berger are used, and the dose rates may be evaluated in any isotropic homogeneous medium of low atomic number and arbitrary density. The program has been used to produce tables of beta dose rate distributions in unit density tissue near point and plane sources of each of the 75 radionuclides. (auth)

9252 (SLA-73-834) EZTRAN2: A USER-ORIENTED VERSION OF THE ETRAN-18B ELECTRON-PHOTON MONTE CARLO TECHNIQUE. Halbleib, J. A. Sr.; Vandevender, W. H. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. Contract AT(29-1)-789. 20p. Dep. NTIS $3.00.

The ETRAN-18B-DATAPAC-4-LIBRARY system for two-dimensional, homogeneous geometries was modified and restructured into a single-run, multiple-job program called EZTRAN2. The procedure was exactly analogous to that employed in the construction of EZTRAN. In particular, the generation of photon cross sections was automated, universal expressions for the density effect for the ionization loss of charged particles were incorporated, and selected input options were suppressed. Compared with EZTRAN, only one additional input card containing three radial parameters is required for EZTRAN2. Control decks are listed for running both EZTRAN and EZTRAN2 from permanent files. (auth)

9253 INTERPOLATION PROCEDURE FOR ENERGY DISSIPATION CURVES OF FAST ELECTRONS. Tabata, T.; Ito, R.; Okabe, S. Annu. Rep. Radiat. Center Osaka Prefect.; 13: 59-64 (1972).

Energy dissipation distributions of fast electrons calculated by Spencer were fitted by a function with four adjustable parameters. The type of electron source considered is plane perpendicular. The rms relative error, in which mean is taken with weights proportional to the square of the fitted value, is generally less than 2%, and is 2.8% in the worst cases. Values of the parameters determined are listed for all the entries in Spencer's table. By using these values, interpolation of Spencer's results in incident energy and absorber atomic number can be achieved simply and precisely. (2 figures, 2 tables) (auth)

9254 PLANAR CHANNELING AND TRANSFER MATRIX TECHNIQUE. Corciovei, A.; Apostol, M.; Mihalache, D. (Inst. for Atomic Physics, Bucharest). Phys. Lett.; 44A: No. 4, 259-260(18 Jun 1973).

A two-dimensional model for planar channeling is given by means of a transfer-matrix technique. Critical energies and angles are calculated and the influence of the temperature is also discussed. (auth)

9255 INTERCALIBRATION FOR LOW-ENERGY PHOTON MEASUREMENTS. Swinth, K. L. (Battelle Pacific Northwest Labs., Richland, WA); Dean, P. N. Health Phys.; 25: No. 6, 599-603(Dec 1973).

In 1970 a group of scientists met and formed an informal committee called the "Intercalibration Committee for Low-Energy Photon Measurements". The purpose of this group was to find a relative basis for discussion and comparison of plutonium whole body counting data and techniques—not to make an absolute intercalibration of counters. This note summarizes the efforts of this group and presents source intercalibration results from the first group of laboratories participating in this phase of the intercalibration. Isotopically pure sources of nominal activities of 5, 50 and 500 nCi of both ^{239}Pu and ^{241}Am were counted in a standard geometry by the ten laboratories participating in the source intercalibration studies. The simple calibration stand used is described. The ratio of the individual laboratory determined activity to the mean activity of the laboratories for the ^{239}Pu and ^{241}Am sources are shown. The detector characteristics for ^{239}Pu (12 to 24 keV) and ^{241}Am (50 to 70 keV) for all the laboratories are tabulated. Normalized sensitivities for each laboratory are given. The intercalibration indicated with one exception good instrumental control between the laboratories and indicates that calibration differences are probably due to errors in calibration standards. Although the agreement between normalized sensitivities and backgrounds is generally good, the disagreement between practically identical detectors is unexplainable in some cases. Differences in coincidence techniques (many of the detectors are CsI–NaI phoswichs), in effective areas of the detector and in natural radioactivity of the construction materials may explain the differences. (UK)

Radiation Source Calibration and Standardization

Refer also to abstract 7773.

Shielding Calculations and Experiments

Refer also to abstracts 8431, 9369, and 9372.

PHYSICS (THEORETICAL)

General

Refer also to abstracts 8693, 8694, 8746, 9665, 9669, 9670, 9675, 9682, 9686, 9699, 9703, 9716, and 9722.

9256 (CNRS-CPT-73-P-547) TRANSLATION INVARIANT STATES IN QUANTUM MECHANICS. Beaume, R.; Pellet, A.; Manuceau, J.; Sirugue, M. (Centre National de la Recherche Scientifique, 13 - Marseille (France). Centre de Physique Theorique). Jun 1973. 44p. Dep. NTIS (U. S. Sales Only) $4.25.

The states of the C. C. R. canonical commutation relations algebra are completely described for finite number of degrees of freedom which are invariant with respect to subgroups of the translation group of phase space. Some well known results of quantum mechanics as the Bloch's theorem are given precisely. (auth)

9257 (JINR-P2-7430) GENERAL FORMULAS AND SELECTION RULES FOR CONFORMALLY COVARIANT OPERATOR PRODUCT EXPANSION. Dao Vong Dyc. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

On the basis of the R-transformation law general formulas were obtained for the conformally covariant expansion of the operator product. The selection rules are mentioned for the case of conserved tensors. The obtained results are transferred directly to the formulas for the conformally covariant two- and three-point correlation functions. (auth)

9258 LONG RANGE FORCES AND BROKEN SYMMETRIES. Dirac, P. A. M. (Florida State Univ., Tallahassee). pp 1-17 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

Some of the reasons which led to the abandonment of Weyl's theory are discussed. It is proposed that Weyl's theory be reintroduced and that it can be developed along parallel lines with a modified Einstein's theory. An outline is given of the development of Weyl's theory. The effect of this theory on symmetry breaking is also discussed. (LBS)

9259 SL(6,C) GAUGE INVARIANCE. Salam, A. (International Centre for Theoretical Physics, Trieste, Italy). pp 55-82 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

The Einstein-Cartan-Weyl theory of spin 2^+ particles is reviewed and its SL(2,C) gauge-invariant character brought out. The theory generalizes to describe a nonet of 2^+ particles when SL(2,C) invariance is extended to the spin and unitary-spin containing group SL(6,C). (auth)

9260 LINEAR METHODS OF APPLIED ANALYSIS. Krall, A. M. Reading, MA; Addison-Wesley Publishing Company (1973). 717p. $9.50.

The topics discussed are some inequalities, linear spaces and linear operators, existence and uniqueness theorems, linear and second order ordinary differential equations, the Stone-Weierstrass theorem, Hilbert spaces, linear and compact operators on a Hilbert space, special functions, the Fourier integral, the singular Sturm-Liouville problem, and partial differential equations. Also covered are distributions, Laplace's equation, the heat equation, and the wave equation. (JFP)

9261 QUANTUM MECHANICS IN A NEW KEY. Lande, A. Exposition-University Book. New York; Exposition Press, Inc. (1973). 141p. $6.50.

The discussion of quantum mechanics covers a discussion of critical experiments, probabilistic structure of events, interference of probabilities, consequences of interference, quantum dynamics, statistical thermodynamics, and observation and interpretation. (JFP)

9262 COLLECTIVE ROTATIONS OF QUANTUM MECHANICAL SYSTEMS. Herold, H.; Letz, H.; Reinecke, M.; Ruder, H.; Volz, H.; Wunner, G. (Erlangen-Nuernberg Univ., Erlangen, Ger.). (1973). vp. (In German).

From spring meeting of the Deutschè Physikalische Gesellschaft, part A: nuclear physics; Heidelberg, Germany (19 Feb 1973).

A method is described for the treatment of collective rotations of quantum mechanical systems. In this method no symmetries of the Hamiltonian are violated and no redundant variables are introduced. Furthermore, it leads to an exact expression for the effective inertia tensor of the system in the limit $L \to 0$ and it gives equations of constraints for the optimal body-fixed coordinate system. (GE)

9263 SPECTRAL PROPERTIES OF THE DIRAC HAMILTONIAN. Weder, R. A. (Univ., Louvain, Belgium). Ann. Soc. Sci. Brux. Ser. I; 87: No. 3, 341-355(1973).

The spectral properties of the Dirac Hamiltonian are investigated for a class of interactions satisfying analyticity conditions with respect to the dilatation group, including the electric potential $V = -g\, r^{-\beta/2}$, and the magnetic potential $|\vec{A}(\vec{x})| = g\, r^{-\beta/2}$, $0 < \beta < 3/2$. (auth)

9264 STOCHASTIC SPACE AND NONLOCAL FIELDS. Blokhintsev, D. I. (Joint Inst. for Nuclear Research, Dubna, USSR). Teor. Mat. Fiz.; 17: No. 2, 153-159(Nov 1973). (In Russian).

A variant of stochastic space is considered, which reveals the specific feature that the field when averaged over this space turns into the nonlocal field leading to macrocausal and unitary S-matrix. (auth)

9265 ASYMPTOTIC BEHAVIOR OF THE FEYNMAN DIAGRAMS. Slavnov, D. A. (Moscow State Univ.). Teor. Mat. Fiz.; 17: No. 2, 169-177(Nov 1973). (In Russian).

Theorem generalizing Weinberg's theorem on asymptotic behavior of Feynman diagrams is proved. Not only the leading asymptotic terms but also the subsequent ones are taken into account. It is shown that if the momenta go to infinity in the Euclidean region, regularized matrix elements of Feynman diagrams can be represented in the form of a polynomial over momenta and their logarithms, plus the terms decreasing faster than any negative power of momenta. (auth)

9266 TRANSFORMATIONS BETWEEN CELLULAR SPACE-TIME STRUCTURES AND THE PRINCIPLE OF COVARIANCE. Cole, E. A. B. (Univ. of Leeds., Eng.). Nuovo Cim.; 18A: No. 3, 445-458(1 Dec 1973).

It is proposed that the space-time used by any observer has a cellular structure which is determined by the observer himself within the limits of the energy available for the refinement of his apparatus. The exact natures of the cells of each structure and the transformations between the cellular structures of different observers are discussed. It is found that these transformations depend on the information exchanged by the observers concerning their placements within their own cellular structures of a common finite set of events, and it is found that the transformations become more exact as more information is exchanged. It is shown how the readings resulting from the application of a set of observables may be grouped in a way which corresponds to the grouping of tensor components in theories involving continuous space-time, and rules are given for the transformations of these groups between observers. It is found that the requirement of the covariance of physical laws within the framework of cellular space-time theory necessitates the use of double-argument transformation operators acting on these groups. (auth)

9267 SOME CONNECTIONS BETWEEN CLASSICAL PHYSICS AND WAVE MECHANICS. Janossy, L. (Central Research Inst. for Physics, Budapest). pp 27-38 of Conference on the Interaction of Electrons With Strong Electromagnetic Field. Budapest; Central Research Inst. for Physics (1972).

From conference on interaction of electrons with strong electromagnetic field; Balatonfuered, Hungary (11 Sep 1972). See CONF-720976-.

The discussion covers the hydrodynamical model and its applications, and interaction with light of high intensity. (JFP)

Quantum Field Theories

Refer also to abstracts 8651, 8747, 8852, 8867, and 8868.

9268 (COO-1764-189) SHORT-DISTANCE BEHAVIOR OF QUANTUM ELECTRODYNAMICS AND THE CALLAN-SYMANZIK EQUATION FOR THE PHOTON PROPAGATOR. de Rafael, E.; Rosner, J. L. (Institute for Advanced Study, Princeton, N. J. (USA); Institut des Hautes Etudes Scientifiques, 91 - Bures-sur-Yvette (France); European Organization for Nuclear Research,

Geneva (Switzerland)). 3 Apr 1973. Contract AT(11-1)-2220. 62p. Dep. NTIS $5.25.

The short-distance behavior of the photon propagator is discussed within the context of the corresponding Callan-Symanzik equation. The Callan-Symanzik function $\beta(\alpha)$ is calculated in perturbation theory up to sixth order. The relation $\beta(\alpha) = \frac{3}{3}(\alpha/\pi) + \frac{1}{2}(\alpha/\pi)^2 - \frac{121}{144}(\alpha/\pi)^3 + O[(\alpha/\pi)^4]$ is found. The simplicity of this result is to be contrasted with a corresponding perturbation theory calculation of the Gell-Mann, Low function $\psi(z)$, whose sixth order coefficient contains the transcendental $\zeta(3)$ (the Riemann zeta function of argument three). A mechanism of cancellations in the calculation of $\beta(\alpha)$ was found, and its validity is proven to all orders in perturbation theory. (auth)

9269 (DESY-73/39) MASSLESS ϕ^4 THEORY IN 4-ELEMENT OF DIMENSIONS. Symanzik, K. (Deutsches Elektronen Synchrotron (DESY), Hamburg (F. R. Germany)). Aug 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00.

The Green's functions of massless ϕ^4 theory in 4-ϵ dimensions are in perturbation theory infrared singular at certain positive rational ϵ. It is shown that the correct expansions of these functions involve additional terms, by which the perturbation theoretical infrared singularities are cancelled. (auth)

9270 (FRNC-R-22) RENORMALIZATION OF YANG–MILLS FIELDS AND APPLICATIONS TO PARTICLE PHYSICS. (Centre National de la Recherche Scientifique, 13 – Marseille (France). Centre de Physique Theorique). 1972. 235p. (CONF-720663-).

The conference included 11 papers three of which were abstracted previously in NSA. For abstracts of these papers see abstract numbers: 27:13171, 27:13289, and 27:23415. (JFP)

For abstracts of individual papers see: 8781–8783 and 9271–9275.

9271 (FRNC-R-22, pp 1-21) APPLICATION OF A MANIFEST COVARIANT APPROACH TO THE YANG–MILLS THEORY. Honerkamp, J. (CERN, Geneva). 1972.

From meeting on renormalization of Yang–Mills fields and applications to particle physics; Marseilles, France (19 Jun 1972).

The construction of an invariant perturbation theory and the formulation of an invariant renormalization procedure for Lagrangian theories processing certain symmetries can be done using the so-called covariant approach. This approach is applied here to the Yang-Mills theory. (auth)

9272 (FRNC-R-22, pp 29-36) REGULARIZATION OF GAUGE FIELD THEORIES. Bardeen, W. A. (CERN, Geneva). 1972.

From meeting on renormalization of Yang–Mills fields and applications to particle physics; Marseilles, France (19 Jun 1972).

It is established that a gauge-invariant regularization of Yang-Mills theories can be made. The only dynamical constraint on the theory comes from cancellation of the anomalies of the free spinor loops. (auth)

9273 (FRNC-R-22, pp 37-75) EXAMPLE OF A GAUGE FIELD THEORY. Hooft, G.; Veltman, M. (CERN, Geneva). 1972.

From meeting on renormalization of Yang–Mills fields and applications to particle physics; Marseilles, France (19 Jun 1972).

The techniques and results of previous work are demonstrated on a simple non-Abelian model. (auth)

9274 (FRNC-R-22, pp 141-176) FEYNMAN RULES FOR MASSIVE GAUGE FIELDS WITH DUAL DIAGRAM TOPOLOGY. Gervais, J. L.; Neveu, A. (Paris Univ., Orsay, France). 1972.

From meeting on renormalization of Yang–Mills fields and applications to particle physics; Marseilles, France (19 Jun 1972).

The relation between dual models and renormalizable theories of massive Yang-Mills fields of the type recently proposed by 't Hooft was studied through the zero slope limit. The theoretic meaning of the twisting operator and the topology of dual models are clarified: these features result from the choice of a special nonhermitian gauge condition in the underlying field theory. The local gauge invariance of that theory is the exact reflexion of the first set of gauge identities appearing in the dual theory. In this nonhermitian gauge, some renormalizable massive vector meson theories are both manifestly unitary and manifestly renormalizable and this leads to a spectacular simplification of the Feynman rules. (auth)

9275 (FRNC-R-22, pp 177-219) APPLICATION OF THE NORMAL-PRODUCT ALGORITHM (N.P.A.) TO ZERO MASS LIMITS, BROKEN SYMMETRIES, AND GAUGE FIELDS. Schroer, B. (Freie Univ., Berlin). 1972.

From meeting on renormalization of Yang–Mills fields and applications to particle physics; Marseilles, France (19 Jun 1972).

It is shown that the NPA is a method appropriate to study zero mass theories and the scale invariant limit. This method is first introduced in the massive Thirring model, and the Callan-Symanzik and renormalization group equations are obtained. They are used to construct the finite zero mass limit. An NPA treatment of broken and spontaneously broken symmetries (in particular the NPA treatment of the sigma model) is presented. The Higgs model is also treated. The gauge invariance criterion for the vector gluon model is discussed. (auth)

9276 (JINR-E2-7456) CONFORMAL COVARIANT OPERATOR PRODUCT EXPANSION (OPE) OF TWO SPIN ½ FIELDS. Dobrev, V. K.; Hristova, E. H.; Petkova, V. B.; Stamenov, D. B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

A conformal covariant operator product expansion (OPE) of two Dirac fields is obtained. The manifest conformal covariant formulation of local quantum field theory is used. (auth)

9277 (ORO-3992-148) INVARIANT BILINEAR FORMS AND THE DISCRETE SYMMETRIES FOR RELATIVISTIC ARBITRARY SPIN FIELDS. Hurley, W. J. (Syracuse Univ., N. Y. (USA). Dept. of Physics; Texas Univ., Austin (USA). Center for Particle Theory). 1972. Contract AT(40-1)-3992. 68p. (CPT-193). Dep. NTIS $5.50.

The existence of an Hermitianizing matrix η is usually assumed in the study of first order relativistic wave equations because it provides for an invariant scalar product, bilinear densities (e.g., Lagrangian) and parity realization in a canonical way. However an η will exist only if the representation of SL(2,C) which governs the transformation of the wave function is self-conjugate. The drawbacks of this fact for theories with $s > 1$ are discussed and a class of relativistic wave equations which avoids these drawbacks and which does not allow for the existence of an η-matrix is set aside for study. It is shown that a dual space may be defined (or, equivalently, a metric operator may be introduced) such that all of the above η-matrix benefits may be maintained without an η-matrix. The discrete symmetries are defined for these equations, and it is shown that the realization of parity in terms of an antilinear operator naturally emerges. The locality, positive definite metric and positive definite energy of the second quantized version of the formulation is described. These considerations apply to a class of wave equations which provide a simple and uniform description of a massive, spin s relativistic particle and which remain consistent and causal in the presence of a minimally coupled external electromagnetic field. (auth)

9278 ELECTRON AND THE MUON AS EIGENSOLUTIONS IN QUANTUM ELECTROMECHANICS. Bopp, F.; Lutzenberger, W. (Ludwig-Maximilians Univ., Munich). pp 183-187 of Fundamental Interactions in Physics. Perlmutter, A. (ed.). New York; Plenum Publishing Corp. (1973).

From Coral Gables conference on fundamental interactions for theoretical studies; Coral Gables, Florida, USA (22 Jan 1973). See CONF-730124-.

A two-component equation for the motion of one charged mass point in its own field without radiation damping is obtained, which yields only two states that are electromagnetically stable. It is conjectured that these two states are those of the electron and muon. (LBS)

9279 SPECIAL THEORY OF RELATIVITY. Muirhead, M. Halsted Press Book. New York; John Wiley and Sons, Inc. (1973). 171p. $12.75.

The topics discussed cover Einstein and relativity, applications of the Lorentz transformation, four-vectors, spin and special relativity, and the Lorentz invariance of physical theories. (JFP)

9280 INDEFINITE-METRIC QUANTUM FIELD THEORY. Nakanishi, N. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto), Suppl.; No. 51, 1-95(May 1973).

Some recent progress in the quantum field theory based on the indefinite-metric Hilbert space is reviewed in a systematic way. Various problems (as shown in the table of contents below) are discussed extensively. The selection of topics is, however, dependent on the present author's interest; undescribed topics are not necessarily meant to be unimportant. An almost complete exposition is given concerning the finite-dimensional indefinite-metric space. On the indefinite-metric quantum field theory, the problem of interpretation and the unitarity of the physical S-matrix are discussed in detail. Also included are a number of new results and remarks on various existing theories. Some of them are construction of a field theory having only one Feynman integral, critical remarks on the quantization of a purely imaginary-mass field and a criticism of the renormalization procedure of the Gupta-Bleuler quantum electrodynamics. (auth)

9281 EQUIVALENCE OF UNITARY- AND RENORMALIZABLE-GAUGE FORMULATIONS OF A MASSIVE GAUGE THEORY.

Shizuya, K. I. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 49: No. 6, 2106-2124(Jun 1973).

By the use of the n-dimensional regularization method, the equivalence of the U- and R-gauge formulations is examined in low-order Green's functions for the Abelian-gauge-field model. Intensively used are the formulae which express a U-gauge Green's function in terms of the R-gauge ones. The occurrence of the U-gauge residual divergences and their cancellations in the S-matrix are then naturally understood in comparison with the R-gauge formulation. (auth)

9282 GAUGE FIELD THEORY. Veltman, M. (European Organization for Nuclear Research, Geneva). (1973). vp.

From international symposium on electron and photon interactions at high energies; Bonn, Germany (27 Aug 1973).

A review is given on the formal aspects of gauge field theory. Starting with the problem of asymptotic freedom, arguments are given for a gauge field theory of strong interactions. Then higher order effects of the weak interaction, the present status of the proof of renormalizability of gauge field theory and the definition of physical particles a la Kibble is discussed. Finally, the question of the validity of PCAC and of low energy theorems is considered. A historical review of the subject, serving at the same time as a bibliography, is presented in an appendix. (GE)

9283 FURTHER STUDIES IN AESTHETIC FIELD THEORY. 3. A Bounded Particle in $\Gamma^i_{jk;l} = 0, g_{ij;k} = 0$ Theory. Muraskin, M. (Univ. of North Dakota, Grand Forks). Int. J. Theor. Phys.; 8: No. 2, 93-97(1973).

In previous papers (Muraskin, Int. J. Theor. Phys.; 7: No. 3, 213 (1973), Muraskin and Ring, Int. J. Theor. Phys.; 8: No. 2, 85 (1973)) it was shown that certain aesthetic ideas led to a bounded particle. It is shown that a theory based on $\Gamma^i_{jk;l} = 0, g_{ij;k} = 0$ with $g = 0$ can also lead to a bounded particle. This theory has the advantage that all tensors constructed from g_{ij}, Γ^i_{jk}, δ^i_j are treated in a uniform way. Also, there are sixty-four distinct Γ^i_{jk} appearing. This was not the case in the previous work. (auth)

9284 SIMPLE PROOF OF THE BOGOLUBOV–PARASIUK THEOREM. Anikin, S. A.; Zav'yalov, O. I.; Polivanov, M. K. (Lebedev Inst. of Physics, Moscow). Teor. Mat. Fiz.; 17: No. 2, 189-198(Nov 1973). (In Russian).

A new proof of the Bogolubov–Parasiuk theorem is given. (auth)

9285 TRANSPORT COEFFICIENTS IN SPECIAL RELATIVITY. de Groot, S. R. (Univ., Amsterdam). Physica; 69: No. 1, 12-20(Oct 1973).

Results are presented on relativistic values of the heat conductivity, the viscosities and related properties, both for systems of massive particles and of neutrinos. The calculations are based on a method recently devised to obtain the transport coefficients for systems of particles with arbitrary cross sections. (auth)

9286 QUANTUM GRAVITY. Isham, C. J. (Imperial Coll. of Science and Tech., London). pp 281-323 of Proceedings of the Seventh Finnish Summer School in Physics, Loma-Koli, Finland, June 26–July 7, 1972. Pellinen, R. (ed.). Helsinki; Univ. of Helsinki (1972).

From 7th Finnish summer school in physics, modern developments in hadron physics; Loma-Koli, Finland (26 Jun 1972). See CONF-720693-.

Some of the approaches to quantizing the gravitational field are outlined. These include non-covariant canonical quantization, covariant canonical quantization, and covariant quantization (non-polynomial lagrangian approach). Some general information on various work currently being undertaken by groups in Trieste and London is discussed: f-g theory, Newman–Penrose constants, and Adler anomalies. (LBS)

9287 DYNAMIC MODEL OF SPIN-1 AND SPIN-0 PARTICLES. Tevikian, R. V. (Yerevan Physics Inst., USSR). Nucl. Phys.; B64: No. 2, 397-406(1973).

In the present work it is proposed to assign two masses to spin-one and spin-zero particles that makes it possible to accurately consider all the feasible limiting cases. The generalization of the Duffin-Kemmer equation involves necessarily in the spin-zero case the introduction of a new, condensate-type state. The two-mass assignment allows us to avoid the formal limiting procedure in Sugawara's theory of currents. To account for the part played by the condensate, the generalized Sugawara's model is considered in field theory, based on the inclusion of the condition of partially conserved axial-vector currents in an SU(2) ⊗ SU(2) symmetry. In this case the introduction of the condensate leads to the mass gain for some of the particles. (auth)

9288 CONFORMAL SYMMETRY IN LAGRANGIAN FIELD THEORY. Srivastava, P. P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Nucl. Phys.; B64: No. 2, 499-510(1973).

Conformal symmetry in Lagrangian field theory is discussed for Lagrangians with derivatives up to first order. Conditions for invariance and covariance of the Lagrangian and for expressing the conformal current as moments of an improved energy-momentum tensor are discussed. (auth)

9289 RENORMALIZATION GROUP AND COMPOSITE FIELD IN WILSON'S THEORY OF CRITICAL PHENOMENA. Jouvet, B. (College de France, Paris). Nuovo Cim.; 18A: No. 3, 459-479 (1 Dec 1973).

After making the distinction between the low-energy and the various high-energy anomalous dimensions of a field, it is shown, by using renormalization group equations, that the quantum field describing statistical mechanical systems near and at the critical temperature is a composite field. The coupling constant is such that the wave function renormalization constant and the inverse of the vertex renormalization constant are both simultaneously null. These constraints, physically introduced by the condition of discreteness of the spin values, imply in general high-energy anomalous dimensions and that discreteness is responsible for scale invariance. The peculiarities of the renormalization group structures of a superrenormalizable model are also illustrated. (auth)

9290 ν-DIMENSIONAL ANALYSIS OF THE AXIAL-VECTOR CURRENT DIVERGENCE. Girotti, H. O. (Univ. Nacional de La Plate). Nucl. Phys.; B64: No. 2, 244-252(1973).

In a formal generalization of some aspects of quantum field theory to a space of continuous dimensionality, the behavior of the axial-vector current divergence is analyzed as an analytic function of the number of dimensions of the space (ν). It is found that $\langle \partial^{\mu_1}_{\mu_1} \rangle_0$ is an analytic function of ν with simple poles at $\nu = 6, 8$, etc. The analyticity of $\langle \partial^{\mu_1}_{\mu_1} \rangle_0$ at $\nu = 4$ results from the cancellation of the $(\nu-4)$ behavior of $\{\gamma\mu,\gamma 5\}$ with the singularity $(\nu-4)^{-1}$ of the product of the Dirac field operators taken at the same space-time point. For $\nu \neq 4$ we have local and non-local contributions to $\langle \partial^{\mu_1}_{\mu_1} \rangle_0$. (auth)

Gravitation and General Relativity

Refer also to abstract 9286.

9291 KILLING TENSORS AND TYPE [2,2] SPACETIMES. Sommers, P. D. Austin, TX; Univ. of Texas (1973). 90p. University Microfilms Order No. 73-26,092.

Thesis (Ph. D.).

In the course of analyzing gravitational fields, special attention is often conferred upon the symmetries of the field and upon the algebraic characterization of the curvature tensor. For space times of type [2,2], the continuous isometries may be derived directly from the special algebraic properties of the curvature tensor. The derivation is valid for all vacuum solutions of this type and for a class of Einstein-Maxwell solutions. The gravitational field of a black hole, as discovered by Kerr, is an important example. The derivation of symmetries centers around the existence of a valence-two Killing spinor. For a large class of the metrics considered, the Killing spinor gives rise to an irreducible Killing tensor of valence two. Formal properties of Killing tensors of arbitrary valence are explored. In particular, the relation of Killing tensors to constants of motion for geodesics and for charged particle orbits is delineated. (Diss. Abstr. Int., B)

9292 SOME ASPECTS OF THE THEORY OF SINGULARITIES IN GENERAL RELATIVITY. Duncan, D. P. Austin, TX; Univ. of Texas (1973). 98p. University Microfilms Order No. 73-26,001.

Thesis (Ph. D.).

Recently two new methods for assigning singular points to a space time manifold were proposed. First a short review is given of the problem of defining singular points in general relativity, and then the new methods are discussed within this context. Explicit applications of these techniques to simple space times are presented and discussed. In addition the application of one of the techniques to the description of matter accreting onto a Schwarzschild black hole is discussed. Also a formalism for associating tensorial quantities with boundary points of a space time is given. It is found that this formalism is useful in discussing the problem of extensions of space times and the relation between the two methods for assigning singular points to a space time. The necessary differential geometric concepts are introduced and discussed as needed. (Diss. Abstr. Int., B)

9293 GRAVITATIONAL-INERTIAL WAVES IN THE GENERAL THEORY OF RELATIVITY. Grigor'eva, L. B.; Zakharov, V. D. Gravitatsiya Teor. Otnositel'nosti; No. 8, 46-57(1971). (In Russian).

Consideration of a definition of gravitational-inertial waves which generally depends on the choice of reference system but is covariant with respect to arbitrary coordinate transformations

which do not change the chosen reference system. The definition of gravitational-inertial waves in this case must be chronometrically invariant and spatially covariant and is based on the introduction of a chronometrically invariant, spatially covariant d'Alembert operator. Wave equations are derived for the chronometrically invariant components of the universal curvature tensor and for the chronometrically invariant characteristics of the reference space, and a study is made of gravitational-inertial waves in Einsteinian spaces. (IAA)

9294 PLANE MONOCHROMATIC ELECTROMAGNETIC WAVES IN GENERAL RELATIVITY THEORY. Golikov, V. I. Gravitatsiya Teor. Otnositel'nosti; No. 8, 38-45(1971). (In Russian).

A covariant generalization is proposed for the concept of plane monochromatic electromagnetic waves in general relativity theory. A class of space metrics which permit propagation of such waves is defined by applying a theorem proved by Shirokov (1955). According to this theorem, the matrix of any covariantly-constant affinor can be reduced to a Jordan canonical form in a certain holonomic coordinate system. (IAA)

9295 ALMOST PROJECTIVE MAPPING OF GRAVITATIONAL FIELDS: DEGENERATE CASE. Dobrovol'skii, V. A. Gravitatsiya Teor. Otnositel'nosti; No. 8, 65-91(1971). (In Russian).

Consideration of the general solution of an almost projective degenerate mapping of a Riemannian space characterized by a certain metric tensor and geodesic complex. A study is made of the system of equations characterizing this conformal mapping, and relations are derived which make it possible to integrate these equations to completion. Using these results, the equations determining a degenerate mapping are integrated in three different cases, and a theorem is derived which gives the behavior of the geodesic complex and the metric tensor during a degenerate mapping of the Riemannian space. (IAA)

9296 TOPICS OF SPACE-TIME TOPOLOGY. Whiston, G. S. (Inst. of Nuclear Physics, Naples). Int. J. Theor. Phys.; 8: No. 2, 99-121(1973).

The orientability properties of space-times are analyzed in detail using elementary algebraic methods. Time, space and charge orientability are discussed and various possible generalizations of charge orientability suggested. There is also a bundle-theoretic analysis of the first two topological properties together with a discussion of spinor-structures from the point of view of the Lorentz bundle of bases over a space-time. Some comments are made on the topologization of certain space-times with topologies derived from their causal relations. (auth)

REACTOR TECHNOLOGY AND REGULATION

9297 (BARC-666) CHEMISTRY OF RADIATION PROBLEMS IN REACTORS. Vartak, D. G.; Prabhu, L. H.; Shah, G. C.; Jose, C. J. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 78p. Dep. NTIS (U. S. Sales Only) $6.00.

The formation of radioactive material in reactor systems, the mechanism of transport of radioactive material into different parts of the systems, the distribution pattern of radiation fields, and methods to decontaminate reactor systems are described in detail. (auth)

9298 (NP-19764) METHODS FOR SURVEILLANCE TESTING OF REACTOR STRUCTURAL MATERIALS. Yasuda, K. (Japan Electric Association, Tokyo). 9 Nov 1972. 12p. Dep. NTIS (U. S. Sales Only) $3.00.

Standards for the surveillance testing of power reactor structural materials in Japan are presented. (JWR)

9299 (NP-19866) NINETEENTH ANNUAL REPORT AND ACCOUNTS 1972/73. (UKAEA London Office). 1973. 114p. Dep. NTIS (U. S. Sales Only) $7.75.

The report is in chapters entitled: general survey; the nuclear power programme (including AGR type reactors, fast reactors, S.G.H.W.R, and HTGR type reactors); fusion research—its progress and prospects; industrial applications and services—nuclear (services to the nuclear power industry, applied nuclear research and development, major nuclear facilities and associated research); industrial applications and services—non-nuclear; health and safety; external relations; finance and administration (finance, the Authority's organization and staff). (UK)

9300 (ORNL-NSIC-112) COMPILATION OF NUCLEAR STANDARDS, 9TH EDITION, 1972. Part I. United States Activities. Final Issue. (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 271p. Dep. NTIS $12.00.

Activities in nuclear standards preparation are presented in tables. Technical, industrial, and environmental organizations preparing standards are listed alphabetically and their activities are given. Approved standards, unapproved drafts, and tentative standards are listed. Standards are indexed by organization and permuted title. (FS)

9301 (WASH-1130(Rev.)) UTILITY STAFFING AND TRAINING FOR NUCLEAR POWER. (USAEC, Washington, D. C.). Jun 1973. 85p. GPO $1.10.

Information on the staffing and training requirements for nuclear power plants is presented under the following headings: importance of top utility management's developing early understanding of nuclear power; staffing the individual utility; national requirements for the next decade; training and education programs and schedules; and sources of training and trained manpower. Appendices contain information on utility management knowledge on staffing and training; USAEC regulatory organization and terminology; typical initial operating crew training schedule; description of education, training, and experience programs; nuclear engineering enrollments and degrees; radiation protection enrollments and degrees; and educational institutions offering courses and degrees in quality control and reliability. 30 references. (DCC)

9302 BRUCE PAVES THE WAY FOR CANADA'S NUCLEAR FUTURE. Jeffs, E. Energy Int.; 10: No. 11, 28-30(Nov 1973).

Two plants were built, one at Point Tupper and the other at Glace Bay, both in Nova Scotia to produce heavy water that was essential to the development of nuclear energy. A third heavy water plant in Ontario was ordered, and so the Bruce project came into being. Bruce consists of a 400 t/year heavy water production unit and a four-unit, 3200 MW power station. It is planned to double the production capacity of the heavy water system. Plans are underway to double the capacity of the power station with the addition of a further four units of similar size. The reactor is described. The first reactor in service will be No. 2 in Aug. 1975. Then No. 1, followed by the third and fourth units will bring the station up to full output by 1978. (MCW)

9303 REACTOR MEETING, KARLSRUHE, GERMANY, APRIL 10–13, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 786p. (In German and English). (CONF-730468-).

Summaries of 192 papers presented at the April 1973 Reactor Meeting at Karlsruhe, Germany are included. Topics discussed include: reactor design and experiments; fuel elements, fuel cycle, and isotope techniques; design, construction, and operation of nuclear reactor facilities and their components; and reactor concepts and economic factors. (DCC)

Power Reactors, Non-Breeding, BWR-Type

Refer also to abstracts 9484, 9490, 9491, 9539, 9550, 9551, 9554–9558, 9560, 9561, 9563–9567, 9569–9571, 9575–9579, 9588, 9599, 9600, 9602, 9604, and 9605.

9304 (BNWL-1771) EXPERIMENTAL STUDY OF FLOW AND PRESSURE IN ROD BUNDLE SUBCHANNELS CONTAINING BLOCKAGES. Rowe, D. S.; Wheeler, C. L.; Fitzsimmons, D. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1973. 98p. Dep. NTIS $5.45.

Measurements of axial velocity, turbulence intensity and pressure distribution in a simple rod bundle model containing partial flow blockages are presented. This information has been obtained to improve the understanding of flow in partially blocked rod bundles and to help verify the use of the COBRA computer program for flow blockage analysis. Recently, the subchannel analysis computer program COBRA-III was modified to perform flow distribution analysis in rod bundles containing "resistance" type flow blockage. The primary modifications, now contained in the COBRA-IIIC computer program, were a more complete transverse momentum equation and improved numerical methods to allow calculations with rather severe "resistance-type" blockages. The development of this capability has relied heavily upon assumptions concerning the inclusion of blockages because of the lack of applicable experimental data. The basic assumptions and suitability of the numerical model for flow blockage analysis are evaluated. Some basic information concerning the flow structure in partially blocked rod bundle channels is presented. (4 references) (auth)

9305 (EIR-234) THREE-DIMENSIONAL CALCULATION OF BOILING WATER REACTORS WITH THE FLARE-EIR PROGRAM. Maeder, C.; Varadi, G. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Jun 1973. 54p. Dep. NTIS (U. S. Sales Only) $4.75.

FLARE-EIR is a modified version of the boiling water reactor simulator FLARE containing a new formula for the nodal coupling coefficient which is based on the one-dimensional one-group response matrix theory. The boundary conditions are represented by albedos that have a clear physical meaning. The quality of the new physics model is investigated by means of three simple test examples which are calculated with diffusion theory in three and one energy groups, with FLARE-EIR and with the original FLARE method. FLARE-EIR contains a new thermohydraulic model for the calculation of the void and mass flow distributions. This model does not require fit parameters that have to be determined with separate computer programs as in the original FLARE version. As a test for FLARE-EIR a startup experiment of the Muehleberg reactor is recalculated, and the results are compared with measurements. (auth)

9306 (GEAP-13317-3) BWR BLOWDOWN HEAT TRANSFER. Third Quarterly Progress Report, January 1–March 31, 1973. (Gulf General Atomic Co., San Diego, Calif. (USA)). Mar 1973. Contract AT(04-3)-189. 119p. Dep. NTIS $5.45.

Analysis of representative data from each of three types of tests has been completed. Analysis of mechanical performance of the bundle has shown that the reusability of the first bundle was limited by deterioration of the sliding electrical connectors. Better performance is projected for the second 16-rod bundle and the 49-rod bundles. Components for the 49-rod bundle and the Two-Loop Test Apparatus (TLTA) have been ordered and modifications to the facility to accommodate the TLTA have been started. (auth)

9307 (GU-5300(Rev.1)) GULF UNITED LIGHT WATER REACTOR FUEL ROD THERMAL–MECHANICAL ANALYSIS METHODS. (Gulf United Nuclear Fuels Corp., Elmsford, N.Y. (USA)). 15 Oct 1973. 103p. Dep. NTIS $7.25.

The principal methods currently in use by Gulf United for the performance of light water reactor fuel rod thermal–mechanical analyses are summarized. These analysis methods are used to evaluate the generally time-dependent thermal–mechanical performance parameters of the fuel rods to applicable performance criteria. The performance parameters of interest include fuel rod axisymmetric clad strain, fuel centerline temperatures, fuel-to-clad gap conductances, and clad asymmetric behavior (ovalization leading to clad collapse). The analysis methods are presented in two parts. The first of these addresses itself to the creep enhanced collapse of tubes under external pressure. The second describes the models used for the thermal–mechanical response

of the fuel and the cladding as a composite fuel rod under reactor operating conditions. The detailed parameters utilized in the analysis models and their bases for selection are described. (8 references) (auth)

9308 (IAE-2261) NUMERICAL METHOD OF THERMO-HYDRAULIC CALCULATION OF THE CONTOURS OF CIRCULATION OF BOILING POWER REACTORS. Rumyantsev, A. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1973. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

9309 (NP-19765) LEAKAGE TESTING OF REACTOR CONTAINMENT VESSELS. Fukuda, S.; Uchida, H. (Japan Electric Association, Tokyo). 1970. 11p. Dep. NTIS (U. S. Sales Only).

Standards for the leakage testing of containment vessels for light water power reactors in Japan are presented. (JWR)

9310 (NYO-10060) STUDY OF MILITARY POWER APPLICATIONS 100 MWe NUCLEAR POWER PLANT: ZMAR-X. (Kaiser Engineers, Oakland, Calif. (USA)). Jan 1962. Contract AT(30-1)-2894. 191p. Dep. NTIS $11.75.

Declassified 27 Aug 1973.

The 100 MW(e) nuclear power plant concept selected for study is presented. An analysis of the design, basis for selection, concept drawings, a construction cost estimate, a project schedule, and estimates for operating, maintenance, and fuel costs are included. Also included are drawings, descriptions, and estimates of cost of alternative facilities for condenser cooling. (auth)

9311 (RISO-289) ASPECTS OF PREDICTION OF THE PERFORMANCE OF A BOILING WATER REACTOR. Petersen, T. (Danish Atomic Energy Commission, Risoe. Research Establishment). Aug 1973. 62p. Dep. NTIS (U. S. Sales Only) $5.25.

Features of the BWR-simulator complex SYNTRONVOID and ELGYFO are described. Calculations were carried out in order to demonstrate effects of various approximations in both hydraulic models and in the flux synthesis method, which is used for the neutron flux calculation. Subchannel calculations were performed for a BWR fuel assembly to investigate effects of nonuniform radial void distribution in an assembly. Examples of prediction of burnout are shown. 19 references. (auth)

9312 (WASH-1270) ANTICIPATED TRANSIENTS WITHOUT SCRAM FOR WATER-COOLED POWER REACTORS. (USAEC, Washington, D.C.). Sep 1973. 94p. GPO $1.10.

A general description of the nature of anticipated transients without scram in water-cooled power reactors is presented. An outline of the results of AEC staff evaluations is given which should provide guidance for applicants and licensees. (JWR)

9313 VIBRATION TESTING EXPERIMENTS FOR FUEL ELEMENTS OF A BWR. Ferrucci, M.; Pitimada, D. (CNEN, Casaccia, Italy). pp 461-492 of Metodi di Calcolo e di Prova di Structture Soggette a Vibrazioni. II. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In Italian).

From conference on computation and test methods for vibrating structures; Pisa, Italy (1972).

Vibration testing experiments to understand the mechanical properties of fuel elements for a BWR are described. The vibration tests are performed with a full scale mockup of the fuel element, using the air to simulate the fuel coolant fluid. The end fixity of each fuel rod and the vibration modes with local sinusoidal loads or with local random loads are examined. To know the vibration modes is considered very important not only for the integrity of the structure but also to avoid a fretting corrosion. Testing facilities and experimental procedures are described in detail and numerical results are reported. (INIS)

Power Reactors, Non-Breeding, PWR-Type

Refer also to abstracts 9304, 9307, 9309, 9312, 9434–9440, 9483, 9496–9498, 9552, 9553, 9559, 9562, 9568, 9572–9574, 9580–9587, 9589–9598, 9601, and 9603.

9314 (BAW-3647-26) PHYSICS VERIFICATION PROGRAM, PART III, TASK 8. QUARTERLY TECHNICAL REPORT, JANUARY–MARCH 1973. McAdams, V. D.; Baldwin, M. N. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Research and Development Div.). Sep 1973. Contract AT(11-1)3109. 56p. Dep. NTIS $5.00.

Experimental task 8 was conducted to determine the detectability of gaps between fuel pellets in a fuel rod by measuring the thermal flux perturbations in the fuel assembly instrument guide tube, by determining the power peaking in fuel rods surrounding a gapped fuel rod, and by determining the power and flux depression due to the presence of an Inconel grid. The experimental assembly–a water-moderated, slightly enriched UO_2 lattice perturbed with a fuel rod containing a void–is arranged to mock up the fuel elements of a commercial pressurized water reactor. Flux in the vicinity of the perturbation was measured with gold wire, and power profiles in fuel rods adjacent to the perturbing pin were measured by counting the fission gamma rays from the rods. These results will serve as a check of analytical calculations on the effects of a fuel gap and its detectability. 7 references. (auth)

9315 (BAW-10057) REACTOR PROTECTION SYSTEM. McNeil, F. B.; Fairbrother, D. B.; Pagnozzi, B. J. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Sep 1973. 55p.

The reactor protection system-II (RPS-II) is described which will be used on Babcock & Wilcox pressurized water reactors that did not receive construction permits before 1973. In this standard system, the relays in the trip logic have been replaced by solid state devices, and a calculating module for the power envelope trip has replaced the overpower trip (based on flow and imbalance) and the variable low-pressure trip. Included are a description of the changes from the present Oconee-type reactor protection system (RPS-I), a functional and hardware description of the calculating module, and a discussion of the qualification program to ensure that the RPS-II is as reliable as, or more reliable than, the RPS-I now used. (auth)

9316 (CEA-CONF-2365) FREON WATER MODELING OF CRITICAL HEAT FLUX IN ROD BUNDLES OF P.W.R. Courtaud, M.; Du Bousquet, J. L. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1973. 20p. (CONF-730665-1). Dep. NTIS (U. S. Sales Only) $3.00.

From European two phase flow group meeting; Brussels, Belgium (4 Jun 1973).

A program concerning the determination of critical heat flux of pressurized water reactors involving studies of the influence of radial heat flux shape, type and position of spacer grids, local blockage is under development in the Heat Transfer Laboratory of the Nuclear Research Center of Grenoble under contract with FRAMATOME. This study is performed with Freon 12, so it is necessary to establish scaling laws. The derivation of these scaling laws is presented. 7 references. (auth)

9317 (DLCS-5000273) SHIPPINGPORT ATOMIC POWER STATION. Quarterly Operating Report, Second Quarter 1973. (Duquesne Light Co., Shippingport, Pa. (USA)). 1973. Contract AT(11-1)-292. 20p. Dep. NTIS $3.00.

Operations aspects, maintenance requirements, and tests performed during April, May, and June 1973 are described. Coolant chemistry measurements recorded during the second quarter are included. (DCC)

9318 (NRC-TT-1699) DETERMINING THE ECONOMIC SIZE OF A PRESSURIZER FOR A PRESSURIZED WATER REACTOR. Fratzscher, W.; Bock, J. Translated by D. A. Sinclair from Kernenergie; No. 9, 285-289(1966). 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Unlike pressurizers that use nitrogen as the medium of compensation, those that use saturated steam have two technical possibilities of preventing undesired increases of pressure due to thermal expansion. These are simple compression of the steam cushion, and water injection. It is shown that the size of a saturated steam volume pressurizer, as a consequence, depends on the nature of the distribution between the two compensating regions. Using an "ordered compensation diagram" it can be shown, however, that there is an optimum distribution ratio for which the total costs for the pressurizer are a minimum. A method of determining this optimum by means of simplified cost expressions is reported. (auth)

9319 (SNE-129) PLUTONIUM-238 PRODUCTION IN COMMERCIAL WATER REACTORS EXPERIMENTAL AND ANALYTICAL PROGRAM. Annual Report for Fiscal Year 1973. Roach, K. E.; Turner, S. E.; Mullett, W. L.; Mitchell, W. III; Gurley, M. D. (Southern Nuclear Engineering, Inc., Dunedin, Fla. (USA)). Jul 1973. Contract AT(11-1)-2322. 97p. Dep. NTIS $5.45.

Activities in the experimental and analytical program for the production of ^{238}Pu in light water reactors are summarized for the 1973 fiscal year. The activities included the irradiation of neptunium targets in the Connecticut Yankee reactor and the destructive examination of the irradiated target. Analytical and economic studies were also performed. (JWR)

9320 (UNC-5246) DEVELOPMENT OF PLUTONIUM RECYCLE IN THERMAL REACTORS. Evaluation of Plutonium Recycle in Pressurized Water Reactors. Tomonto, J. R.; Tulenko,

J. S.; Fiscella, J.; Ray, J. (Alpha Chemie und Metallurgie G.m.b.H. (ALKEM), Hanau (F. R. Germany); Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Wolfgang/Hanau (F. R. Germany); United Nuclear Corp., Elmsford, N. Y. (USA)). 10 Sep 1969. 214p. Dep. NTIS $12.75.

An evaluation of the utilization of plutonium recycle fuel in the Obrigheim power reactor was performed in order to study the characteristics of typical large PWR's operated with plutonium recycle fuel. The evaluation included nuclear characteristics, fuel management, a thermal-hydraulic analysis, and an economic analysis. (JWR)

9321 (WAPD-MRP-140) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report for the Period January 26–July 25, 1973. (Bettis Atomic Power Lab., Pittsburgh, Pa. (USA)). 1973. Contract AT(36-1)-GEN-14. 16p. Dep. NTIS $4.00.

Plant operations and testing with all four reactor coolant loops in service continued satisfactorily during this period, and the total operating time with PWR-2 Seed 2 was increased to approximately 9180 equivalent full power hours (EFPH). The operating limits of PWR Core 2 Seed 2 were evaluated for swing load operation for the interval from 9000 to 11,000 EFPH. Revised operating limits were put into effect which eliminated some existing restrictions on plant operation. The evaluation of observed fission product levels in the reactor coolant verified the absence of Zircaloy fuel cladding defects. The M-160 shipping container training and checkout program to load the first M-160 with PWR Core 2 Seed 1 spent fuel clusters has begun. The program for improving liquid radioactive waste disposal systems continued. (auth)

9322 (WCAP-7920) INDIAN POINT STATION, UNIT 2. Primary Loop Vibration Test Program. Olsen, B. E.; Singleton, N. R.; Bohm, G. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Sep 1972. 82p.

Electrodynamic shaker forces were applied to the Indian Point Unit 2, Primary Loop 1 to determine the natural frequencies, mode shapes, and damping characteristics of the loop components; the steam generator, main coolant pump, and primary coolant piping. The majority of the testing was done during the cold hydrostatic test period (7/7/70 to 7/18/70) with primary coolant temperatures of 70 to 150°F. For these tests a maximum shaker force of 150 pounds was used. Subsequent tests were run on the steam generator in the temperature range of 150°F (2/17/71) to 480°F (2/28/71) with shaker forces of 300 to 800 pounds. Accelerations were measured at approximately 20 locations during each test. Vibration levels at operating conditions were measured during the cold hydrostatic test period for Loop 1 pump operation (7/17/70) and during the hot functional test period (1/19/71 to 2/28/71) for Loop 1, 2, 3, and 4 pump operations totaling 26 pump/temperature combinations. The data were analyzed with analog (filters), hybrid (real time spectrum analyzers), and digital (MACRAN) techniques. With these techniques, a resolution of 10^{-3} g's (0.1 mils peak displacement at 1 Hz) was obtained. The shaker beat method proved effective in providing adequate on-site information to define the various system modes and in producing accurate data for subsequent determination of mode shapes, natural frequencies, and damping. The loop frequency spectra at various operating conditions contain, besides the component natural frequencies, pump-speed-related frequency components at shaft and blade-passing speeds, plus their harmonics. These components dominate the frequency spectra of the reactor coolant pump. The 3σ deflection levels (three times the standard deviation) of the random frequency components and zero-to-peak levels of the pump speed components were calculated from these spectra. (auth)

9323 (WCAP-8110(SUPP. 4)) TEST PLANS AND RESULTS FOR THE ICE CONDENSER SYSTEM. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 15 Nov 1973. 33p.

Results of dynamic re-testing of a top deck door and a lower inlet door shock absorber cover for the ice condenser system are presented. (DCC)

9324 (WCAP-8118) MEASURED CHARACTERISTICS OF XENON INDUCED X–Y OSCILLATIONS IN THE H. B. ROBINSON UNIT 2 NUCLEAR POWER PLANT. Frank, F. J.; Felentzer, D. P.; Lee, J. C. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Apr 1973. 55p.

An X–Y xenon oscillation test was performed at the H. B. Robinson, Unit No. 2 plant. The results of these measurements, which began with a core average burnup of 1540 MWD/MTU, demonstrated that the core is stable to X–Y oscillations with a stability index of $-0.076\ hr^{-1}$. The X–Y xenon oscillation test was simulated analytically using a two-dimensional diffusion code. The calculated stability index of $-0.081\ hr^{-1}$ is in good agreement with the measured value of $-0.076\ hr^{-1}$. (13 references) (auth)

9325 (WCAP-8219) FUEL DENSIFICATION EXPERIMENTAL RESULTS AND MODEL FOR REACTOR APPLICATION. Hellman, J. M. (ed.). (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Oct 1973. 29p.

Based on an extensive study of the performance of Westinghouse uranium oxide fuel and experimental results, a model is presented to quantitatively describe the densification process and its effect on core performance for all Westinghouse Zircaloy clad fuel assemblies. The data used for this study includes measurements of stack height shrinkage and interpellet gap distributions from in-core flux traces, gamma scanning and destructive testing of irradiated fuel rods, incore measurements of neutron flux spikes from interpellet gaps of known size, and DNB testing of simulated fuel rods with axial power spikes. The model is based on the observation that the extent of densification of fuel produced by the Westinghouse process is dependent primarily upon both initial density and the pellet sintering temperature. Fuel densification does not occur instantaneously as previously assumed, but is time dependent. This temporal dependence is included in the model. Based on these observations, new product specifications have been established which minimize the amount of incore densification for Westinghouse fuel. Analysis of the data has shown that the prepressurization of fuel rods as currently done by Westinghouse significantly reduces the number of densification caused interpellet gaps. As a result of this lower gap frequency and refinements of the nuclear calculational technique, a new power spike model is presented for cores containing rods with uncollapsed or collapsed gaps. Applying the new power spike model to fuel manufactured under current Westinghouse specifications results in a 5% spike factor at the top of the core. Fuel manufactured to earlier product specifications and analyzed with the then current densification model yielded an 18% spike factor at the top of the core. The decrease in amount of densification and spike factors results in a significant increase in core power capability and peaking factor safety margin. (auth)

Power Reactors, Non-Breeding, Graphite Moderated

9326 (CONF-730668-2) HIGH TEMPERATURE GAS-COOLED REACTOR. Shepherd, L. R. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). 1973. 7p. Dep. NTIS (U. S. Sales Only) $3.00.

From strategy for the development of nuclear steelmaking symposium; London, UK (6 Jun 1973).

The advantages of HTR systems are presented. Core design is discussed and comparison is made between fuel elements for Fort St Vrain and for Dragon. Uses of HTR type reactors for multi-purpose heat, high efficiency steam cycles and use with gas turbines are considered. Problems associated with the achievement of high temperatures, such as behavior of materials, particularly those for heat exchangers, and also problems of coolant impurity, are discussed. Some results of the Dragon experimental program on the behavior of stressed and unstressed specimens in HTR helium are summarized. (UK)

9327 (EUR-5032) APPROACH TO EQUILIBRIUM IN HTR. A Comparison Between Thorium and Low-Enriched Cycle. Graziani, G.; Rinaldini, C. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Oct 1973. 35p. Dep. NTIS (U. S. Sales Only) $3.75. EUR B.Fr. 50.-.

A comparison between thorium and low-enriched cycles in HTR power reactors has been carried out considering not only the equilibrium fuel cycle, but also the running-in period for both cycles. Zero and one dimensional calculations were performed which show a good agreement with previous calculations. (auth)

9328 (GULF-GA-A-12714) PSC PRE-NUCLEAR PELTON WHEEL CAVITATION REPORT. (Gulf General Atomic Co., San Diego, Calif. (USA)). 2 Aug 1973. Contract AT(04-3)-633. 77p. Dep. NTIS $5.45.

During the Hot Flow Test, the motive power for the circulator is supplied by pressurized water from the emergency feedwater system, which drives each circulator through a Pelton wheel turbine. These Pelton wheels are larger and capable of delivering much more power than the ones used in regular plant operation (2500 hp vs. 560 Hp). They are also made of a different material (17-4 PH vs. Inconel 718). After a few hundred hours of operation, circulators 1A and 1D showed higher than specification wobble readings. Circulator 1C would not self-turbine after planned shutdown and 1B could not be brought up to full speed because of the inability to achieve full flow of the turbine water. After instrumentation integrity was established, the circulators were removed for inspection. The wobble of 1A and 1D circu-

lators was caused by an out of balance condition due to the loss of buckets (weakened by cavitation damage) from the Pelton wheel. The rotation of the 1C circulator was prevented by the ingestion and wedging of foreign metal particles in one of the water seals. The restriction in water flow to the Pelton wheel of circulator 1B was due to a piece of a tool file in one nozzle, and a portion of a valve trim in another nozzle. The chronological sequence of events that led to the shutdown of the four circulators is described, and the causes of wheel degradation and bucket failure are discussed. A comparison of the cavitation damage pattern with the kinematics of jet impingement provided guidance in formulating a cavitation suppression test program. This program, performed in the Circulator Test Facility, and its results are discussed. A description is given of the nitrogen pressurization system designed to create sufficient backpressure in the turbine cavity to prevent cavitation. In addition, results of 300 hours of running with the corrective system are presented. (auth)

9329 (JUL-985-RW) DETERMINATION OF A GEOMETRY-DEPENDENT PARAMETER AND DEVELOPMENT OF A CALCULATION MODEL FOR THE DESCRIPTION OF THE FISSION PRODUCTS-TRANSPORT OUT OF SPHERICAL FUEL ELEMENTS IN GAS-COOLED GRAPHITE MODERATED REACTORS. Weissfloch, R. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorwerkstoffe). Jul 1973. 76p. (In German). Dep. NTIS (U. S. Sales Only)$6.00.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

The fuel elements of high-temperature reactors, coated with pyrolitic carbon and covered with graphite release fission products like all other fuel elements. Because of safety reasons the rate of this release has to be kept low and has also to be predictable. Measured values from irradiation tests and from post-irradiation tests about the actual release of different fission products are presented. The physical and chemical mechanism which determines the release is extraordinarily complex and is not clearly defined. Because of this, a simplified calculation model was developed which only considers the release-mechanisms phenomenologically. This calculation model coincides very well in its results with values received in experiments till now. It can be used as an interim method on the way to a complete theory. (auth)

9330 (RD/B/M-2738) EXAMINATION OF THE METHODS OF FUEL PIN RIB HEIGHT MEASUREMENT. Bisseker, G. W. E. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Jul 1973. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

The heat transfer performance of an AGR fuel pin depends critically upon the rib height, which for experimental work may be in the range 0.20 to 0.50 mm. An accurate method of rib height measurement suitable for transverse and helically-ribbed pins is therefore required to interpret heat transfer and pressure drop test results. The various techniques which have been used at BNL are described and compared. A method using a Nikon measurescope is found to give the most accurate and repeatable results. This method is significantly better than the others and is suggested for future work, together with a standard format for the presentation of rib height measurement data. (auth)

9331 (TRG-Report-2480) EFFECT OF MANUFACTURING TOLERANCES ON THE EFFECTIVE FRICTION FACTOR OF A NUMBER OF PARALLEL PASSAGES. Wilkie, D. (UKAEA Reactor Group, Risley). Oct 1973. 8p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

The effect of variations in friction factor within an array of parallel passages is discussed in general terms and in relation to CAGR fuel element clusters. (auth)

9332 RECENT DEVELOPMENTS AND PROSPECTS OF HTGR's. Casa, A. F.; Fiorentini, P. Com. Naz. Energ. Nucl., Notiz.; 19: No. 6, 39-74(Jun 1973). (In Italian).

This updating of a 1970 report reviews the present status of high-temperature gas-cooled reactors and on the possible future uses for both power generation and industrial process purposes. The present situation of HTGR's in Europe and in the U. S., the development of plant technology and, in particular, fuel, the operating experience acquired with the prototype plants now in operation or under construction and with the first commercial plants are discussed. Finally, studies on the feasibility of adopting a direct-cycle instead of steam-cycle gas turbine loop, and of the possible uses in industrial process applications are reviewed. (auth)

9333 EMERGENCY COOLING OF A GAS-COOLED NUCLEAR REACTOR. Hannerz, K. (to AB Asea-Atom). US Patent 3,769,157. 30 Oct 1973. Priority date 25 Aug 1970, Sweden. 4p.

For emergency cooling of a nuclear reactor plant, there is provided a primary flow circuit for cooling gas through the reactor core, and then through the primary sides of a reheater and a main steam generator, to a main circulator pump which returns the gas to the core. Another flow circuit is provided which conducts condensed water from a turbine condenser to the secondary side of a main steam generator, and conducts the steam produced therein through a high pressure part of a main turbine and then to the secondary side of the reheater and to the low pressure part of the main turbine and to the condenser. Condensed water from the condenser is also pumped into an auxiliary generator parallel with the main steam generator where it is vaporized and the steam produced is conducted to the secondary part of the reheater, and then to a turbine which drives the main circulator. A shunt conduit in connection with a shunt valve is arranged to connect the outlet of the secondary side of the main steam generator to the inlet of the drive turbine of the main circulator. (Official Gazette)

Power Reactors, Non-Breeding, Otherwise Moderated

9334 (AECL-4435) DECONTAMINATION OF THE DOUGLAS POINT GENERATING STATION BY CYCLING TECHNIQUES. Montford, B. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Oct 1973. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

Radiation fields were reduced by 85 percent around the Monel boilers at Douglas Point Generating Station by a series of cycling decontaminations in the period October 1971 to April 1972. Decontamination of carbon and stainless steels was less successful. The radiation fields from carbon steel were reduced by 10 to 30 percent. 500 to 800 Curies of ^{60}Co were removed from the heat-transport equipment by the decontaminations. This was removed by establishment of oxidizing conditions in the coolant prior to shutdown, then after shutdown application of temperature and hydraulic cycles and a change back to reducing condition in conjunction with operation of a high-capacity purification system. Corrosion measurements indicate that an insignificant amount of corrosion occurred during the decontamination period. 8 references. (auth)

9335 (AEEW-R-608) JOSHUA: A THREE DIMENSIONAL, COUPLED NUCLEAR-THERMAL-HYDRAULICS CODE FOR BURN-UP STUDIES IN LIQUID COOLED REACTORS. Hopkins, D. R. (UKAEA Reactor Group, Winfrith. Atomic Energy Establishment). Aug 1968. 29p. Dep. NTIS (U. S. Sales Only) $3.50.

JOSHUA is a three-dimensional, two-group diffusion code incorporating irradiation burnup of the fuel elements, and including the effect of coupled hydraulics on the steady state flux distribution. It is written in S2 Fortran for the Aldermaston STRETCH computer. The MAGOG flux and burnup routine is included as the basis of the method, with the hydraulic feed-back loop included through the addition of a flow routine allied to a library of nuclear data tabulated from METHUSELAH calculations. All the flux and control options included in MAGOG are also included in JOSHUA, but the scope is extended to include a total reactor flow control option on reactivity suitable for use in the study of Natural Uranium SGHW Systems. The calculation of power-dependent Xenon and Doppler effects are also included in the flux computation. Output needed for re-start cases is provided by the automatic production of re-start tapes, card output being reduced to a minimum. Standard output is printed from magnetic tape. 8 references. (auth)

9336 (AREAEE-168) NPC-I: A FORTRAN PROGRAM FOR CALCULATION OF NUCLEAR PARAMETERS FOR ROD-CLUSTERED PRESSURE-TUBE LATTICES. Sabek, M. G.; Nassar, S. F. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 57p. Dep. NTIS (U. S. Sales Only) $5.00.

NPC-I program is a FORTRAN program for calculating the four factors formula of rod-clustered pressure-tube lattices. The calculation of the various parameters in the four factors formula, namely ϵ, P, and f is based on the use of collision probabilities, treating the fuel cluster as a structure of subcells within the lattice cell. The factor η is given as input data. The computations are carried out on the ICL-1905E computer. 6 references. (auth)

9337 (CONF-721006-P2, pp 522-536) EXPERIENCE IN SODIUM TEST FACILITIES AND COMMISSIONING OF KNK WITH A VIEW TO FAST SODIUM-COOLED REACTORS. Kirchner, G.; Herberg, S.; Hendl, G.; Schaefer, U.; Albat, W. (INTERATOM, Bensberg, Ger.). 1973. (In German).

From international conference on engineering of fast reactors

for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The Kompakte Natriumgekühlte Kernreaktoranlage Karlsruhe (KNK) is in its final phase of commissioning. Following the fourth partial operation license, 50% (10 MW) of the nominal electric power could be generated for the power supply grid for the first time on August 10, 1972. Commissioning had begun in November 1969 when installation work was nearing completion. Commissioning had to be interrupted repeatedly due to events and information, which had to be taken into account, requiring considerable time and expense. Study and development work carried out in the test facilities on systems for sodium precipitation from the cover-gas is described in detail. Experience in KNK during the commissioning phase of power generation is discussed in particular with respect to the control of the decrease of the sodium heat span (160°C) after scram. (auth)

9338 (DP-MS-73-39) PRODUCTION OF DELAYED PHOTONEUTRONS FROM ^{235}U IN HEAVY WATER MODERATOR. Baumann, N. P.; Currie, R. L.; Pellarin, D. J. (Du Pont de Nemours (E.I.) and Co., Aiken, S.C. (USA). Savannah River Lab.). [nd]. Contract AT(07-2)-1. 15p. (CONF-731101-40). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

Experiments with a shuttling ^{252}Cf source indicate a significantly lower yield of delayed photoneutrons from ^{233}U fission products in heavy water (D_2O) than given by current literature ($\beta = 6.7 \times 10^{-4}$ vs. 10.2×10^{-4}). The major discrepancy was observed for the 2.5-second group. The group structure was found to be more complex than given by earlier data. Pulsed neutron experiments failed to verify the existence of recently reported photoneutron groups at 0.004 and 0.074 seconds. (8 references) (auth)

9339 (DP-MS-73-46) RESPONSE MATRIX METHOD AND THE COSINE-CURRENTS APPROXIMATION. Pryor, R. J. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1973. Contract AT(07-2)-1. 19p. (CONF-731101-21). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The response matrix method was applied to a reactor of 37 hexagonal cells. Our calculations show that usual cosine-currents approximation made at the cell interface led to significant errors in radial leakage, and some variation in the angular distribution of neutrons crossing this interface was required. Our calculations further show that the quarter-space cosine-currents approximation adequately satisfies this angular variation requirement, improves the current distribution, and accurately predicts radial leakage. (auth)

9340 (TRG-Report-2433) RELEASE OF FISSION PRODUCTS FROM ZIRCALOY-CLAD UO_2 FUEL AT AROUND 1000°C. Hillary, J. J.; Taylor, J. C. (UKAEA Reactor Group, Sellafield). 9 Mar 1973. 13p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

Fission product release experiments have been carried out with Zircaloy-clad UO_2 fuel pins including two which were available from an irradiation experiment in SGHWR. The pins were caused to fail in flowing steam at ~1000°C, which are conditions relevant to some SGHWR fault situations, and the escaped fission products ^{133}Xe, ^{131}I, and in some cases ^{85}Kr, were trapped and measured. The results of these experiments are assessed with a view to providing the best present estimates of inert gas/^{131}I release ratios for use in reactor incident evaluation. 4 references. (auth)

9341 (WASH-1223) EVALUATION OF THE GAS COOLED FAST REACTOR. (USAEC Division of Reactor Development and Technology, Washington, D. C.). Sep 1972. 46p. GPO $0.75.

Earlier evaluations of the technical status, economic feasibility, and possible benefits of the gas cooled fast reactor are reviewed. The various GCFR concepts are discussed and the technical developments that have taken place since the earlier evaluations are described. The research and engineering efforts and their costs for the further development of the gas cooled fast reactor are assessed. (JWR)

9342 VIBRATION MEASUREMENTS ON FUEL ROD COOLED BY A TWO-PHASE FLUID (GAS AND LIQUID). Cedolin, L.; Hassid, A.; Rossini, T. (CISE, Milan). pp 493-509 of Metodi di Calcolo e di Prova di Structture Soggette a Vibrazioni. II. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In Italian).

From conference on computation and test methods for vibrating structures; Pisa, Italy (1972).

Vibration measurements on fuel elements for the CIRENE reactor are described reporting in detail the instrumentation used and the test procedures. Each fuel element is composed by 19 rods connected by terminal grids. The fuel element is cooled by a two-phase fluid flow. The experimental circuit IDRA at CISE labs was used for the tests. The experimental data were processed by the CISE computer program PAFFT. Numerical results and diagrams are reported. (INIS)

Power Reactors, Breeding

Refer also to abstracts 7668, 8256, 8316, 9380, 9441–9473, 9476–9482, 9485, 9486, 9489, 9494, 9502, 9503, 9515, and 9532.

9343 (AI-AEC-13112) FUELS, MATERIALS, AND CONTROL ROD DEVELOPMENT PROGRAMS. Quarterly technical Progress Report, July–September 1973. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Nov 1973. Contract AT(04-3)-824. 32p. AT.

The studies include the radiation effects on void formation and mechanical properties of Type 316 stainless steel, helium generation in ^{10}B and other reactor materials, and control absorber heating experiments. (DCC)

9344 (AI-AEC-13114) LMFBR IN-VESSEL STORAGE REFUELING COMPONENT DEVELOPMENT PROGRAM. Quarterly Technical Progress Report, July–September 1973. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Nov 1973. Contract AT(04-3)-824. 29p. AT.

Progress in the development and testing of handling devices for core components for an LMFBR plant with under-the-shield refueling and reactor vessel core rotating plugs is reported. The devices tested include a vertical motion in-vessel transfer machine and an ex-vessel transfer machine for off-line removal of fuel from the reactor in-vessel storage. (DCC)

9345 (ANL-CT-73-20) PROPOSED METHOD FOR INCLUDING CREEP AND SWELLING IN THE ANALYSIS OF LMFBR DUCTS. McLennan, G. A. (Argonne National Lab., Ill. (USA)). Sep 1973. 54p. AT.

An operational version of a new 2-dimensional non-linear elastic code NUBOW is presented. This code is capable of treating most, if not all, features of currently suggested core-restraint designs. This includes such things as variable cross-sectional properties for fuel assembly ducts, local flexibility at contacts, and clearance gaps at all supports and load pads. NUBOW, which has been described as a "beam theory" code as opposed to a "finite-element" code, was designed to utilize the fact that the LMFBR ducts are beam-like members which can be described by well-established classical beam theory, and this problem does not require the generality inherent in the finite-element approach. (4 references) (auth)

9346 (ANL-RDP-19) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, AUGUST 1973. (Argonne National Lab., Ill.). 28 Sep 1973. Contract W-31-109-eng-38. 155p. AT.

Progress in fast breeder development studies is reported under the following headings: EBR-2; LMFBR design support; instrumentation and control; fuels and materials development; reactor physics; reactor safety; and GCFR fuels and materials development. (JWR)

9347 (CONF-721006-P1, pp 271-297) RELIABILITY ANALYSIS OF THE DECAY HEAT REMOVAL FOR SNR. Zeibig, H.; Blombach, J.; Heuser, F. W.; Rosenhauer, W. (Interatom, Bensberg, Ger.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Starting with general safety considerations, the demands on the systems required for the decay heat removal are defined. These demands are quantified by the results of block consequence analyses of the whole plant assuming a tolerable total risk. Detailed investigations of the sodium pumps and the power supply system are presented. The results are used in a fault tree analysis of decay heat removal. The cases determining the safety of the plant are considered. The final results show that using quantitative reliability methods a general understanding of the systems is attained and, even more important, that the systems meet the requirements compatible with the tolerable total risk. 10 references. (auth)

9348 (CONF-721006-P1, pp 322-335) SNR EMERGENCY COOLING: HEAT TRANSFER CALCULATIONS ON IN-TANK NATURAL CIRCULATION WITH BLANKET BACKFLOW. Timmermann, F.; Vossebrecker, H. (INTERATOM, Bensberg, Ger.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The SNR is equipped with an emergency cooling system whereby the decay heat is transported out of the tank by 6 sodium immersion coolers. The heat transport from the core to the coolers is realized by in-tank natural convection loops with backflow in the blanket. A special computer code has been developed which describes the dynamic behavior of the in-tank flow. Calculations have been made for an accident whereby the sodium level in the tank sinks down to the emergency level as a consequence of a rupture of a main sodium pipe with simultaneous failure of the pump shutdown. The results demonstrate that the in-tank natural convection is capable of transporting the decay heat from the fuel to the immersion coolers. 3 references. (auth)

9349 (CONF-721006-P1, pp 336-349) PHENIX EMERGENCY COOLING SYSTEM. Megy, M. J. M. (CEA, Paris); Giudicelli, M. A. G.; Robert, M. E. A.; Crette, M. J. P. 1973. (In French).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The protective system is described which is designed to remove the decay heat in emergency in case of complete loss of all normal decay heat removal systems. The normal decay heat rejection systems are first presented. Incidents being able to lead to the loss of these normal means are then analyzed. The protective system and its constructive characteristics designed for emergency cooling and based on two independent and highly reliable circuits entirely installed outside the primary containment vessel are described. (auth)

9350 (CONF-721006-P1, pp 381-398) PROTECTIVE INSTRUMENTATION FOR FAST REACTORS. Smith, R. D. (United Kingdom Atomic Energy Authority, Risley, Eng.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The instruments are considered in two main groups: those protecting the reactor against incidents which affect the whole core; and those which protect against incidents which in the first instance affect only one sub-assembly. A third minor group covers instruments needed for refuelling. The first group presents relatively few problems, but the development of instruments monitoring the performance of single sub-assemblies is more difficult, particularly because of the need to minimize spurious reactor trips. Instruments such as reactivity meters and acoustic noise detectors offer a possible solution, but may give inadequate signal to noise ratios. The proposals for protective instruments on current large fast reactor designs are tabulated. 5 references. (auth)

9351 (CONF-721006-P2, pp 473-491) ENSURING SAFE OPERATION OF BOR-60 REACTOR. Kazachkovskii, O. D.; Gryazev, V. M.; Krasnoyarov, N. V.; Kevrolev, V. P.; Afanas'ev, B. A.; Smirnov, A. M.; Kondrat'ev, B. I. (Scientific Research Inst. of Atomic Reactors, Dimitrovgrad, USSR). 1973. (In Russian).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The investigation results on the effects of the steady-state reactivity, of natural circulation regimes, of the emergency cooling and transients during scram system trip are presented. The description is given of the changes in the systems and in technological process, and the operational reliability of the equipment and of the reactor systems is verified. 3 references. (auth)

9352 (CONF-721006-P2, pp 537-563) PEC SAFETY APPROACH. Di Sapia, R. (CNEN, Bologna); Olivieri, P.; Palamidessi, A.; Santandrea, E.; Sarto, S.; Imperiali, F. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

P.E.C. Safety Analysis criteria are based on a scheme which assesses fault sequences on the basis of the expected frequency of the initiating fault and the probability of failure of the protective systems provided. Frequency and failure probability are not used as continuous parameters but as a discontinuous index of the standard of equipment. 9 references. (auth)

9353 (CONF-721006-P3, pp 1106-1130) EXPERIMENTAL RESULTS ON STRUCTURE SUBJECTED TO DYNAMIC LOAD IN PEC TEST PROGRAM. Cenerini, R. (EURATOM-CCR, Ispra, Italy); Curioni, S.; del Grande, A.; Millioni, G.; Verzeletti, G.; Albertini, C.; Montagnani, M. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

A considerable percentage of the energy released in case of a hypothetical accident in the reactor core is found in the form of deformation energy of the structure which constitutes the radial and axial reactor containment. In the case of the PEC fast reactor, the shielding plug is one of the most stressed structures owing to its particular geometric configuration; it is therefore necessary to constrain it so to avoid the damaging of the overhanging structures in case of accident. A system constraining the plug to the supporting structure by means of deformable bolts is described. The influence of some parameters on the response of the bolts of PEC reactor plug following a dynamic strain is analyzed. 8 references. (auth)

9354 (CONF-730726-1) IRRADIATION EXPERIMENT OF SODIUM BOND CARBIDE FUEL IN RAPSODIE. Clottes, G.; Dufayet, J. P.; Ratier, J. L.; Dieumegard, M.; Groff, A.; Kryger, B.; Mikailoff, H. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France); CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1973. 21p. (SM-173/8). Dep. NTIS (U. S. Sales Only) $3.25.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

Work performed under United States–Euratom Fast Reactor Program.

A sodium bonded fuel assembly containing 19 pins was irradiated in fast reactor Rapsodie. Several types of fuel have been tested: (U,Pu)C mixed carbides–(U,Pu,Mo)C carbide alloy–(U,Pu)CN carbonitride–(U,Pu)N nitrides, stress being laid on the (U,Pu)C mixed carbide, as 10 fuel elements of this type have been irradiated. The results concerning the behavior of (U,Pu)C-based fuel elements are presented. 10 references. (auth)

9355 (CONF-730726-2) BEHAVIOR OF IRRADIATED URANIUM CARBIDE PELLETS AT HIGH BURNUP. Delbrassine, A.; Coquerelle, M. (Centre d'Etude de l'Energie Nucleaire, Mol (Belgium); Commission of the European Communities, Karlsruhe (F.R. Germany). European Inst. for Transuranium Elements). 2 Jul 1973. 17p. (SM-173/1). Dep. NTIS (U. S. Sales Only) $3.00.

From symposium on fuel and elements for fast reactors; Brussels, Belgium (2 Jul 1973).

Work performed under United States–Euratom Fast Reactor Program.

Since substoichiometric monocarbide swells due to the presence of a metallic phase and the sesquicarbide is not thermodynamically compatible with the austenitic steels, it is essential to manufacture a monocarbide which is as pure as possible. In order to extend the small domain of existence of this single phase fuel, so as to facilitate the fabrication, a research program was undertaken at the CEN/SCK regarding the stabilization of the monocarbide. Vanadium and chromium were retained as stabilizers and added to the carbide so as to obtain a three-phase fuel; MC-VC-V_2C and MC-Cr-$Cr_{23}C_6$. Out-of-pile tests have confirmed the perfect compatibility of these two types of fuel with austenitic steel. The oxygen content was taken into consideration as an extra parameter, since any strict limitation of this content would inevitably increase the fabrication cost. In order to obtain a rapid comparison of the behavior of these fuels, a series of uranium carbide pellets, the burnup of which ranges from 65.000 to 110.000 MWd/t, were irradiated in POM-STUC devices. 17 references. (auth)

9356 (CONF-731101-27) ORNL HIGH-TEMPERATURE STRUCTURAL DESIGN METHODS DEVELOPMENT PROGRAM. Greenstreet, W. L. (Oak Ridge National Lab., Tenn. (USA)). 1973. 20p. Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

A program to develop and evaluate high-temperature structural design methods and criteria for use in the design of Liquid Metal Fast Breeder Reactor (LMFBR) system components is described. Inelastic behaviors of these components under time-varying temperature and load conditions are of primary interest. Time-varying temperature conditions are especially important because, in addition to producing significant changes in material properties, large thermal strains can be induced due to the good heat transfer characteristics of the sodium coolant. The program addresses three major aspects; these are (1) deformation behavior, (2) failure associated with creep rupture, brittle fracture, fatigue, creep-fatigue interactions, and crack propagation, and (3) the establishment of appropriate design criteria. Included in the first category are studies of materials behavior, the development of mathematical analogs, or constitutive equations, to describe the essential features of this behavior, and the development and assessment of structural analysis methods. The materials of interest are types 304 and 316 stainless steel, and temperatures of interest range to 1200°F. (auth)

9357 (COO-2245-3) COOLANT MIXING IN LMFBR ROD BUNDLES. Quarterly Progress Report, March 1, 1973–May

31, 1973. Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1973. Contract AT(11-1)-2245. 34p. Dep. NTIS $4.00.

Experimental programs and analytical models are reviewed concerning liquid sodium mixing in bundle geometry (wrapped and bare rods) and subchannel geometry (bare rods). 7 references. (DCC)

9358 (COO-2245-4) REVIEW OF RECENT ANALYTICAL AND EXPERIMENTAL STUDIES APPLICABLE TO LMFBR FUEL AND BLANKET ASSEMBLY DESIGN. Khan, E.; Todreas, N. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1973. Contract AT(11-1)-2245. 51p. (MITNE-152). Dep. NTIS $5.45.

The recent analytical and experimental efforts for predicting flow and temperature fields in LMFBR wire wrapped assemblies are critically discussed and the "State of Art" presented. Points of similarity and differences between various studies in this area are indicated in an effort to form a coherent picture of the accomplishments and future analytical and experimental needs. 32 references. (auth)

9359 (COO-2245-5) SIMPLIFIED APPROACH FOR PREDICTING TEMPERATURE DISTRIBUTION IN WIRE WRAPPED ASSEMBLIES. Khan, E.; Rohsenow, W.; Sonin, A.; Todreas, N. (Massachusetts Inst. of Tech., Cambridge (USA)). Sep 1973. Contract AT(11-1)-2245. 51p. (MITNE-153). Dep. NTIS $5.45.

A novel semi-empirical method has been developed for predicting temperature distributions in wire wrapped rod bundles of a Liquid Metal Fast Breeder Reactor. The lumped eddy diffusivity model developed greatly simplifies the prediction and computational procedure yet takes into account the important, identifiable, modes of energy re-distribution within the rod bundle. The accuracy of predictions was found to be as good as the more complicated subchannel analysis codes. Two dimensionless groups necessary for predicting energy redistribution within the bundle are identifiable and their dependence on various geometrical parameters of the rod bundle is quantitatively established with the help of existing data. 17 references. (auth)

9360 (EURFNR-1116) TEMPERATURE AND HEAT-FLUX DISTRIBUTION IN THE MOLTEN CORE MASS OF A GCFR AFTER A HYPOTHETICAL MELT-DOWN ACCIDENT. Barleon, L.; Dalle Donne, M.; Dorner, S. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Neutronenphysik und Reaktortechnik). Nov 1972. 22p. (KFK-1755; EUR-4852). Dep. NTIS (U. S. Sales Only) $3.25.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Although a simultaneous loss of both coolant pressure and all of the coolant circulations appears to be too unlikely in a properly designed GCFR-system as to be taken as design basis accident, the question about temperature and heat-flux distribution in the molten core mass contained in a Core-Catcher would be of great interest. It was assumed that the molten core mass has reached the core catcher after 100 sec, and that the melt is separated into an oxide and a metallic phase. Depending on their state, the fission products will be in the metallic and oxide melt or in the helium main circuit. Based on indications from the literature, the calculation of temperature distribution was made on the assumption that 50% of the afterheat arises in the oxide, 30% in the metallic phase and 20% in the helium main circuit. The calculation of the temperature distribution was based on a model in which a solidified fuel layer on the core catcher cooled at the bottom is followed by a stagnant liquid fuel layer, at the upper limit of which the maximum temperature of the melt is reached. This maximum temperature line represents the heat flux divide. Above this line heat in the liquid fuel melt will be transported upwards by natural convection. According to this model the steel layer is located above the fuel melt. Depending on the given heat production in the core melt, additional layers are found in the model. A numerical program was prepared which allows one to calculate the temperature and heat flux distributions in the melt. The material data required for computation were taken from the literature. In these initial computations values have been used which do not completely take into account the interactions of components present in the melt. The results obtained give an indication of the design and technological measures which are necessary to solve the problem of the molten core mass in a core catcher within the pressure vessel. (auth)

9361 (GEAP-13919-4) LMFBR HEAT EXCHANGER MATERIALS DEVELOPMENT PROGRAM. Fourth Quarterly Progress Report, March 1973–June 1973. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jun 1973. Contract AT(04-3)-893. 26p. Dep. NTIS $4.00.

Progress in the LMFBR heat exchanger materials development program is reported for the following tasks: localized corrosion of heat exchanger materials in water-contaminated sodium systems; effects of interstitial transport on design properties of heat exchanger materials; and stress corrosion, localized corrosion and general corrosion of heat exchanger materials. (JWR)

9362 (GEAP-13956) CORE RESTRAINT SYSTEM TESTS AND ANALYSIS. Phase II. Planar Internally Tightened Core. Magee, P. M.; Marian, V. R.; Meserve, C. E. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jun 1973. Contract AT(04-3)-893. 38p. AT.

Tests of a core restraint system employing internal tighteners to load and restrain the reactor core were conducted using the Planar Clamping Model (PCM) at HEDL. Other than the yoke shimming required to accommodate the periphery of the internally tightened core, no significant facility modifications from the external clamped configuration previously tested were required for these tests. Important characteristics of internally tightened hexagonal channel arrays when subjected to inward-directed peripheral loads and during tightener actuations were observed, photographed, and measured. All tests were conducted using an array of 31 internal tighteners and 168 channels. Each aluminum alloy channel was 4.719 inches across flats, 0.270 inch in wall thickness, and 4 inches long. Each actuating internal tightener was a regular hexagon in form which was 4.719 inches across flats when retracted and 4.890 inches across flats when expanded. Both the tighteners and the channels were flame sprayed with a coating of alumina (Al_2O_3) 0.0025 inch thick to increase the interchannel coefficient of friction to a measured value between 0.68 and 0.75. 3 references. (auth)

9363 (GEAP-13967) EVALUATION OF MATERIAL PROPERTY CORRELATIONS USED IN LIFE-II. Hilbert, R. F.; Cantley, D. A.; Kangilaski, M.; Stephen, J. D.; Craig, C. N. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jun 1973. 31p. Dep. NTIS $4.00.

Material property correlations currently (February 1973) used in the fuel rod design code LIFE-II were evaluated in detail. New correlations, based on the best available data, are recommended for incorporation into the code in several areas including: fuel-cladding gap conductance, fuel thermal conductivity, cladding swelling and cladding creep. In the case of property correlations that were judged unacceptable and require a major development effort, recommendations for near-term action are provided. (auth)

9364 (GULF-GA-A-12780) CRITICAL EXPERIMENT PROGRAM FOR THE 300-MW(e) GAS-COOLED FAST BREEDER REACTOR: SCOPE AND PURPOSE. Moore, R. A. (Gulf General Atomic Co., San Diego, Calif. (USA)). 17 Oct 1973. Contract AT(04-3)-167. 57p. Dep. NTIS $5.45.

A program of critical assembly experimentation in support of the Gas-Cooled Fast Breeder Reactor (GCFR) Program is outlined. Specific tasks needed for early resolution of GCFR design uncertainties are delineated and a brief program of critical assembly work that draws heavily upon the national LMFBR work is outlined. The scope of the program needs for special materials and equipment is examined and a preliminary design for the first assembly is presented. (31 references) (auth)

9365 (LIB/Trans-481) VIBRATIONAL BEHAVIOR OF THE INTERMEDIATE HEAT EXCHANGERS OF THE REACTOR PHENIX. Andro, J.; Boulot, F.; Kayser, G. Translated by W. Buykx from Houille Blanche; 26: No. 6, 491-498(1971). 31p. Dep. NTIS (U. S. Sales Only) $3.75.

The methods used to investigate intermediate heat exchanger tube vibrations in the Phenix reactor, due to the primary circuit sodium flow, are described. Two different approaches are made to the problem, one by calculation, comparing natural and possible excitation frequencies, and the other an experimental approach using a model intended for purely hydraulic research. The limitations of each method are described and it is shown that resonance cannot occur. (FR)

9366 (LMEC-73-6) DYNAMIC MODEL FOR TESTING THE ATOMICS INTERNATIONAL-MODULAR STEAM GENERATOR IN THE SODIUM COMPONENTS TEST INSTALLATION. Griffin, C. W. (ed.). (Liquid Metal Engineering Center, Canoga Park, Calif. (USA)). 30 Jun 1973. Contract AT(04-3)-700. 152p. AT.

An analog model was developed for simulating the transient testing of the Atomics International-Modular Steam Generator (AI-MSG) in the Sodium Components Test Installation (SCTI) at the Liquid Metal Engineering Center (LMEC). The model was used to predict the transient response of the facility and test article to normal power transients and to specified upset and emergency transients prior to initiation of testing. Performance of the model exceeded expectations; the dynamic response and reliability of the system was excellent. (auth)

9367 (ORNL-TM-4062) ORNL USER'S MANUAL FOR CREEP-PLAST COMPUTER PROGRAM. Clinard, J. A.; Crowell, J. S. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 100p. AT.

This report summarizes program operations and provides necessary user information to implement CREEP-PLAST, a two-dimensional finite element computer program for creep and plasticity analysis of metal structures operating at high temperature. 5 references. (auth)

9368 (ORNL-TM-4234) HIGH-PERFORMANCE HEATERS FOR LMFBR FUEL ROD SIMULATION: STATUS REPORT. MacPherson, R. E.; Clark, D. L.; Donnelly, R. G. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 106p. AT.

The LMFBR thermal-hydraulics program requires high-performance electric heaters that can be fabricated to simulate the configuration and operational capabilities of a nuclear fuel pin. Oak Ridge National Laboratory (ORNL) has been working with commercial vendors to develop a reliable source for a functional and relatively inexpensive cartridge electric heater for this purpose. Heaters having FFTF fuel pin configuration for operation at 800,000 Btu $hr^{-1}ft^{-2}$ in 1200°F sodium (category I) are considered state of the art, providing appropriate quality control measures are instituted over manufacturing variables during fabrication. These heaters normally have a nickel–chromium alloy spiral wire heating element, boron nitride insulation, and a 316 stainless steel sheath. Internal instrumentation to measure cladding surface temperatures can be provided. Heaters of the same geometry for operation at 10^6 Btu $hr^{-1}ft^{-2}$ in 1800°F sodium (category II) can be fabricated by optimizing the category I design. This optimization involves the use of high-purity boron nitride as the insulation and of an iron–chromium–aluminum alloy spiral ribbon heating element. Heaters of this type have been tested sufficiently to demonstrate their ability to perform at the specified levels of heat flux and sodium temperature; however, insufficient testing has been done to fully qualify a commercial vendor for their production. A third type of heater of FFTF fuel pin geometry is required to operate at 10^6 Btu $hr^{-1}ft^{-2}$ and to survive for short periods into sodium boiling and expulsion transients wherein the cooling mechanisms operative on the heater are not yet well defined (category III). This level of performance has been demonstrated in tests employing heaters similar to category II heaters but equipped with refractory metal or refractory alloy heating elements. Again insufficient testing has been done to fully qualify a commercial vendor. (auth)

9369 (ORNL-TM-4402) FAST REACTOR ANALYTICAL SHIELDING PROGRESS REPORT FOR JULY AND AUGUST 1973. 189a No. 10318, Activity No. HN 04 01 01 1. Abbott, L. S.; Childs, R. L.; Engle, W. W.; Maerker, R. E. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 79p. AT.

Analytical shielding work performed for the fast reactor program during the months of July and August included calculations for both the FFTF and the Demo plant, computer code development, analyses of TSF experiments, and a cross-section sensitivity study of a TSF experiment. Most of the FFTF studies were aimed at determining the effect of various design changes on the dose rates at the maintenance deck during reactor operation, in particular, the effects of penetrations through the radial cavity shield and the effect of a new design for the head temperature control system shield. Gamma-ray dose rates due to the activated sodium coolant were also calculated for two locations in the system: around one of the branch-arm piping shields and near the entrances of the 28-in. and 16-in. coolant lines into the IHX cell. The main Demo plant study was for the lower axial shield region; another study has been initiated to calculate the Demo stored-fuel power and the ex-vessel detector response. The code development consisted in setting forth a set of specifications for the fourth version of the discrete ordinates code DOT. The TSF experiments that were analyzed were an experiment in which secondary gamma-ray production in iron-polyethylene configurations was investigated and another in which the transmission of the Westinghouse spectrum modifier and 5-in. radial blanket was measured. The sensitivity study was performed to demonstrate that estimates of the accuracy of calculations for the FFTF and Demo plant can be deduced from a sensitivity study of an experimental configuration that only roughly mocks up the real system. (auth)

9370 (TRG-Report-2236) PREFERRED VALUES FOR THE THERMAL CONDUCTIVITY OF SINTERED CERAMIC FUEL FOR FAST REACTOR USE. Washington, A. B. G. (UKAEA Reactor Group, Risley). Sep 1973. 95p. Dep. NTIS (U. S. Sales Only) $6.75. UK £2.00.

Thermal conductivity data published for sintered oxide, carbide and nitride compounds of uranium and uranium-plutonium nuclear fuels are assessed, and preferred values are given with particular reference to fast reactor conditions. Where possible the effects of stoichiometry, porosity, cracking and other variables are included. Fuel-to-clad conductances in typical fast reactor fuel pins are also discussed and preferred values quoted. 131 references. (auth)

9371 (WARD-CR-3045-3) CORE RESTRAINT DEVELOPMENT. Quarterly Progress Report for Period Ending August 31, 1973. French, J. W. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Nov 1973. Contract AT(11-1)-3045. 35p. AT.

The National Core Restraint Development Program Plan (WARD-295) was issued August 23, 1973. Key milestones for core restraint development have been identified to provide the support necessary for the LMFBR Demonstration Plant program. A meeting was held on August 17 with GE/BRD, AEC/RRD, ANL, and ARD to discuss the scope of analytical studies to be performed during FY-74. Development of a three-dimensional, elastic, analytical code for core restraint analysis has been initiated by ANL. Preparations are also being made at ANL to develop a semi-empirical model for three-dimensional inelastic studies. A specification is being prepared by GE/BRD to develop a transient thermal analysis code; this document should be completed by January 1, 1974. Installation and construction of the test facility is now complete. Final adjustments are being made to position the jaw assemblies at the proper elevation for Demonstration Plant tests. Design of the simulated fuel assembly is complete. Procurement of hardware necessary for 121 assembly test has been initiated. Testing is scheduled to start in late November. Conceptual design of the instrumented load measurement assembly has been completed at GE/BRD. Procurement of equipment necessary for duct bow measurement has been initiated. (auth)

9372 (WARD-SS-3045-3) RADIAL BLANKET AND SHIELD SIMULATION EXPERIMENTS. Analysis of Experimental Results. Rittenberger, R.; Gibson, G.; Ritts, J. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Nov 1973. Contract AT(11-1)-3045. 116p. AT.

A description of the experimental program is presented. The method of analysis is discussed including the analytical model, the cross sections, and the codes used in the analysis. Detailed comparisons of the calculations and experiments are presented. (JWR)

9373 (WASH-1222) EVALUATION OF THE MOLTEN SALT BREEDER REACTOR. (USAEC Division of Reactor Development and Technology, Washington, D. C.). Sep 1972. 59p. GPO $0.85.

Topics discussed concerning the molten salt breeder reactor program include: resource utilization; historical development of molten salt reactors; molten salt breeder reactor concept description; status of molten salt breeder reactor technology; and industrial participation in the molten salt breeder reactor program. (17 references) (DCC)

9374 VARIABLE THICKNESS ENVELOPE NUCLEAR FUEL ASSEMBLY. Chenal, J. C.; Schaller, K.; Skok, J.; Venobre, H. (to Commissariat a l'Energia Atomique). French Patent 2,135,074. 5 May 1971. 11p. (In French).

A description is given of a fuel assembly consisting of at least one bundle of elongated clad fuel pins, these pins being arranged parallel to one another in a regular lattice, and an envelope containing the bundle, this envelope being cooled by a coolant fluid flowing in a direction generally parallel to the pins. The thickness of the envelope in the downstream part (considered in the same direction as the fluid flow) is less than that in the upstream part. (FR)

9375 NUCLEAR FUEL ASSEMBLY. Chenal, J. C.; Schaller, K.; Skok, J.; Venobre, H. (to Commissariat a l'Energie Atomique). French Patent 2,134,104. 20 Apr 1971. 11p. (In French).

A nuclear fuel assembly is presented which contains at least one bundle of elongated clad fuel pins arranged parallel to one another in a regular lattice; the bundles are contained in an envelope in which a coolant fluid circulates. Means are provided for circulating the coolant along the envelope at a temperature such that the temperature of the envelope above the bundle is such that the degree of swelling under irradiation is considerably less than the maximum swelling. The envelope is made of stainless steel and is maintained at a temperature outside of the 450 to 500°C range. (FR)

9376 NATURAL MODES OF THE CIRCULAR BEAM SUPPORTING THE TRAVELLING CRANE OF THE PEC REACTOR. Cesari, F. (CNEN, Rome); Mangoli, P.; Taroni, A. pp 147-164 of Metodi di Calcolo e di Prova di Structture Soggette a Vibrazioni. II. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In Italian).

From conference on computation and test methods for vibrating structures; Pisa, Italy (1972).

Mechanical vibration modes of the supporting structure for the traveling crane of the PEC reactor are calculated. The structure

examined is a circular beam supported by vertical pillars. An analytical expression for the free vibration eigenvalues is derived and numerical calculations with different beam dimensions are performed. A computer program for IBM 7094 was written to solve this specific problem. Numerical results and diagrams are reported. (INIS)

9377 REACTOR VESSEL SUPPORTING DEVICE. Costes, D. (to Commissariat a l'Energie Atomique). US Patent 3,769,161. 30 Oct 1973. Priority date 9 Jul 1970, France. 4p.

In a nuclear reactor comprising a main vessel filled with a hot heat-transporting liquid and surmounted by a cold shield slab with interposition of a gas blanket, the reactor vessel is supported by a cylindrical shell having a diameter which is slightly larger than the vessel, the top portion of the shell is secured to the vessel in leak-tight manner and the bottom portion of the shell is secured to a peripheral corbel of the vault which contains the vessel and which is closed by the shield slab. (Official Gazette)

9378 INFRARED NDT OF ELECTRICAL FUEL PIN SIMULATORS USED IN LMFBR THERMAL HYDRAULIC TESTS. Green, D. R.; Collingham, R. E.; Fischer, L. H. (Hanford Engineering Development Lab., Richland, WA). Mater. Eval.; 31: No. 12, 247-254(Dec 1973).

Electrical resistance heating is used to simulate nuclear heating in fuel pin simulators that are used in LMFBR thermal hydraulic sodium tests. Thermal uniformity is essential in these simulators to ensure that data obtained with them is meaningful. Mechanical integrity of the units is also important for timely and economical completion of the thermal hydraulic tests. An infrared line scanner is used as part of a testing system that is routinely applied to assure the quality of LMFBR fuel pin simulators used in tests at the Hanford Engineering Development Laboratory. Typical defects that can be detected by this system include: 1) regions of abnormal density in the heater core-to-clad insulator, 2) displacement of the heater core away from center, 3) flaws or thinning in the heater core that would cause localized abnormal heat production, 4) thinning and some other types of cladding flaws, and 5) defects in the braze joint between the copper "cold ends" and the nichrome core. Thermal analyses, destructive analyses, and improved performance of the simulators have shown that the infrared nondestructive test results are valid. (auth)

Research, Test, and Experimental Reactors

Refer also to abstracts 9346, 9368, 9475, 9487, 9533, 9535, and 9536.

9379 (ANL-7542(Add. A)) CATALOG OF ROD-DROP AND TRANSFER-FUNCTION DATA FROM EBR-II RUNS 32-46. Larson, H. A.; Engen, I. A. (Argonne National Lab., Ill. (USA)). Sep 1973. Contract W-31-109-eng-38. 43p. AT.

Reactivity-perturbation experiments using the rod-drop method have been conducted in EBR-II since run 25. Feedback-reactivity data for runs 25-30, as obtained from rod-drop and oscillator tests, were presented in ANL-7542. This addendum to that report presents feedback-reactivity data for runs 32-46, as obtained from rod-drop tests with two rods having differently shaped reactivity-insertion curves. 17 references. (auth)

9380 (ANL-8003) RE-SOLUTION-CONTROLLED FISSION-GAS BEHAVIOR IN UO_2 IRRADIATED IN EBR-II. Pati, S. R.; Dapht, M. J.; O'Boyle, D. R.; Patrician, T. J. (Argonne National Lab., Ill. (USA)). Aug 1973. Contract W-31-109-Eng-38. 40p. AT.

Uranium dioxide irradiated in EBR-II to a burnup of 2×10^{20} fissions/cm^3 between 650 and 1400°C has been examined by transmission- and scanning-electron microscopy and replication metallography. The fission-gas distribution in the fuel matrix and grain boundaries has been characterized as a function of irradiation temperature and fission rate. Irradiated specimens also were annealed out-of-reactor, and the resultant fission-gas-bubble distribution was compared with the as-irradiated distribution. The majority of fission gas produced, even at the highest irradiation temperature, was found to be in the UO_2 matrix, either in solution or in the form of bubbles < 20 Å in diameter. The results are explained on the basis of irradiation-induced re-solution of fission gases that re-inject gas from within gas bubbles to metastable solution in the lattice. Calculated fission-gas solubilities are given as a function of temperature for 10^{13}, 3×10^{13}, and 10^{14} fissions/cm^3-sec. Based on these results, it is concluded that the re-solution process is operative over a substantial fuel volume of a typical LMFBR mixed-oxide fuel element. (36 references) (auth)

9381 (ANL-CT-73-17) FINAL REPORT ON VERIFICATION TESTING OF THE FFTF PUMP SHAFT ANNULAR PUMP DOWN FEATURE. Smith, F. A.; Shin, Y. W.; Coover, K. (Argonne National Lab., Ill. (USA)). Jul 1973. 69p. AT.

The purpose of this test was to verify a specific design feature of the FFTF Sodium Pump called a "Pump Down Device". Verification of the Pump Down Device was accomplished by this test using a .38 scale model, which employs water, of the sodium pump down device. The diameter of the pump rotor shaft is 28" compared to an equivalent model rotor diameter of 10.7". The purpose of the Pump Down Device on the FFTF Sodium Pump was to develop a vortex which would create sufficient head to remove sodium from the annular gap between the pump rotor shaft and the stationary inert gas filled support cylinder. Theoretical analysis of rotating flows and a description of the model test facility are presented. (8 references) (auth)

9382 (AREAEE-162) THERMAL-NEUTRON ENERGY SPECTRUM AND THE THERMAL GROUP CONSTANTS OF THE UA-RR-1 REACTOR. Gaafer, M. A.; El-Cherif, A. I.; Nassar, S. F. (Atomic Energy Establishment, Cairo (Egypt)). 1972. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

The energy spectrum of thermal neutrons in the UA-RR-1 reactor has been obtained by numerical solution of the space dependent Wigner–Wilkins diffusion equation with mixed number density. This spectrum was then used to calculate the thermal group constants: absorption cross-section, fission cross-section, diffusion coefficient and the thermal diffusion length. For the sake of comparison the corresponding thermal groups based on the Maxwellian distribution have been also computed. 5 references. (auth)

9383 (CONF-721006-P1, pp 434-453) ACOUSTIC DETECTION OF BUBBLE EMISSION IN THE RAPSODIE REACTOR. Bret, A.; Gaillard, M.; Lechel, V. (CEN, Cadarache, France). 1973. (In French).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The acoustic detection instrumentation of the reactor Rapsodie is described. The results of acoustic measurements obtained during the study of the operational parameters are included. The detection of argon entrainments is analyzed. (auth)

9384 (CONF-721006-P2, pp 492-509) OPERATING EXPERIENCE WITH RAPSODIE CONCERNING COMPONENT RELIABILITY. Gajac, G. (CEN, Cadarache, France). 1973. (In French).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

A registration system is described for such incidents in RAPSODIE which have had a feedback on the reactor operation. The incidents are categorized according to the material concerned, and according to the loss of reactor operation time. Comments are made about the time evolution of the frequency of incidents of each category. It is suggested that general rules for the categorization of such incidents should be set up and agreed upon, in order to enable a comparison of observations of this type for all reactors. (auth)

9385 (CONF-721006-P2, pp 510-521) SEFOR OPERATING EXPERIENCE AND SIGNIFICANCE TO LMFBR's. Arterburn, J. O.; Hikido, K. (General Electric Co., Sunnyvale, CA). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The Southwest Experimental Fast Oxide Reactor (SEFOR), having satisfactorily accomplished its objectives of providing safety data and operating experience vital to LMFBR development, was shut down on January 4, 1972. The test program directed to experimental determination and demonstration of the inherent safety characteristics of the fast spectrum, mixed-oxide fueled, sodium-cooled reactor and in particular, the Doppler coefficient, was completed almost exactly as planned eight years earlier. With the completion of the test program, decommissioning of the SEFOR facility was initiated. Test operations and maintenance requirements are reviewed. 9 references. (auth)

9386 (CONF-731112-4) REAL TIME ANALYZER FOR INVERSE KINETICS ROD DROP EXPERIMENTS. Churchich, M. K.; Mott, J. E.; Robinson, J. C.; Piety, K. R. (Tennessee Univ., Knoxville (USA)). 1973. 16p. Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

A system is described that measures subcritical reactivity in

nuclear reactors by the Inverse Kinetics Rod Drop (IKRD) technique. The analyzer was used in a large scale reactivity experiment performed in the Fast Flux Test Facility (FFTF) engineering mock-up core loaded in the ZPR-9 at Argonne National Laboratory. The hardware used in the system included (1) a computer operating in a real time environment, (2) an interface to condition the signals from seven neutron sensors located in the reactor core and to transfer them into the computer at fixed time intervals (provisions were made to interface signals from individual neutron detectors operating in either the current or the pulse mode of operation), and (3) a cassette tape recorder for permanent storage of the raw data. The system allows the operator to determine the reactivity condition of the reactor immediately. (auth)

9387 (CONF-731112-9) FAST NEUTRON HODOSCOPE AT TREAT: OPERATIONAL EXPERIENCE AND IMPROVEMENTS. De Volpi, A. (Argonne National Lab., Ill. (USA)). [nd]. 6p. Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

The multichannel hodoscope at TREAT is capable of detecting motion of fuel resulting from intentional meltdown of fuel pins contained within a test capsule. The system has been in operation in its present form since 1969, having participated in over 50 transients. Operational experience and evolutionary improvements are discussed. The rather complex hodoscope system, which is supported by an involved series of steps before results can be achieved, has worked well within design prediction. Computer-aided reconstruction of the data has been provided to obtain displays, plots, and movies of fuel motion events. (auth)

9388 (GKSS-71/E/18) INVESTIGATIONS OF THE REACTOR DYNAMICS OF THE FRG-1 REACTOR BY STOCHASTICALLY DRIVEN CONTROL RODS. Raschti, M. A. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (F. R. Germany)). 1971. 73p. (In German). Dep. NTIS (U. S. Sales Only) $5.75.

The frequency curve of the FRG-1 was measured at zero-power (0.3 kW) as well as at 5 MW power for the frequency range of 0.002 to 0.1 Hz with the help of a stochastically driven control rod with the least possible disturbance of the steady load operation. A simple dynamic model was developed for the FRG-1 to interpret the measurements with power, which only show a single temperature feedback. From this the theoretical frequency curve has been determined. By comparing the experimental frequency curve with the model calculation, the temperature coefficient was determined. A calibration curve of the control rod is not necessary for the determination of the reactivity equivalent of the temperature coefficient as the measurement at zero power had given the frequency curve of the free-from-feedback ^{235}U reactor. (GE)

9389 (GKSS-72-E-30) BURN-OUT EXPERIMENTS IN HEATED RECTANGULAR CANALS UNDER FRG CONDITIONS. Fries, S.; Hofmann, K.; Petersen, G. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1972. 40p. (In German). Dep. NTIS (U. S. Sales Only) $4.00.

By means of an electrically heated test measuring section, a part of a flow channel of a FRG element was reproduced. The temperatures of the entering and leaving water as well as the temperatures on the heating plates were measured with thermo-elements. The heating surface load of the heated plates which limit the flow channel and the flow rate of the water could be varied within certain limits. The maximum heating surface load reached in the test, with which a stationary safe operation was still possible, was 165 W/cm^2, which if transferred to the FRG-2 corresponds approximately to a reactor capacity of 35 MW. Heat conductivity strips were made of Kantal cut in steps, whose cross section curve approached that of a cosine formed distribution of the heating surface load. The measured results are shown. The heat conducting strips temperatures are noted above the given heating surface distribution at that time. (GE)

9390 (HEDL-SA-552) NUCLEAR DESIGN ASPECTS OF THE FAST TEST REACTOR. Little, W. W.; Ramchandran, S. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1973. 23p. (CONF-731015-2). Dep. NTIS $3.25.

From IAEA conference on physics of fast reactors; Tokyo, Japan (16 Oct 1973).

The nuclear design and analysis of the Fast Test Reactor is summarized. The key design parameters and the areas that posed the most severe challenge to the nuclear design techniques are emphasized. (JWR)

9391 (HEDL-SA-575) OPTIMIZATION OF THE CLIPPING TIME CONSTANT FOR BF_3 NEUTRON DETECTORS OPERATED IN A HIGH LEVEL GAMMA ENVIRONMENT. Brown, D. P. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 8 Oct 1973. Contract AT(45-1)-2170. 15p. (CONF-731112-10). Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

The results of an experimental study conducted to determine the electronic clipping time constant required to achieve an optimum neutron sensitivity for BF_3 tubes used in high gamma fields (1000 R/hr) are described. The use of appropriate time constants reduces the gamma effects, or pulse pileup, and maintains an acceptable neutron signal pulse height, thus resulting in optimized operation of the detectors. (auth)

9392 (HEDL-SA-613) PRESSURE LOSS COEFFICIENTS FOR STAGGERED MULTIORIFICE/SHIELD PLATES. Spalek, J.; McCormack, J. D. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1973. Contract AT(45-1)-2170. 14p. Dep. NTIS $3.00.

The hydraulic characteristics of flow control multiorifice plate assemblies designed for the FFTF reactor were investigated. The pressure drop flowrate characteristics determined in the test are presented. (JWR)

9393 (HEDL-TME-72-86) EFFECT OF LIQUID SODIUM ON FFTF IHX TUBE-TO-TUBESHEET WELD RESIDUE DEPOSITS. Yunker, W. H. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1972. Contract AT(45-1)-2170. 22p. AT.

Black deposits, about 20 mil diameter and 5 mil thick, formed during tube-to-tubesheet weld qualification tests for the FFTF Intermediate Heat Exchanger. The behavior of these spots in liquid sodium has been studied in the temperature range 400°F to 800°F in flowing and in stagnant sodium. The results show that the spot-like deposits disintegrate in a few hours into many smaller pieces and do not come loose from the metal as single pieces. The dissolution/disintegration can be assumed to continue after the fragments are released into the sodium. The total mass of material released is estimated to increase the impurity level in the FFTF primary sodium by 0.004 wppm. (auth)

9394 (HEDL-TME-73-62) EBR-II DOSIMETRY TEST (REACTOR RUNS 50G AND 50H). Jackson, J. L.; McElroy, W. N.; Ulseth, J. A.; Kellogg, L. S. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1973. Contract AT(45-1)-2170. 111p. Dep. NTIS $5.45.

A cooperative dosimetry test by the Argonne National Laboratory (ANL) and the Hanford Engineering Development Laboratory (HEDL) was conducted during EBR-II runs 50G and 50H. The primary objectives of the HEDL effort were to establish relative differences between fission rates and flux-spectra obtained from reactor physics calculations and the multiple foil method. An important goal was to reduce the relative differences to well below 10% for the central core region. Other objectives were to determine absolute uncertainties in reaction rate and flux spectral data, to measure local distortions of the energy dependent integral flux-spectra and fission rates due to differences in composition of driver fuel and experimental subassemblies, and to extend the current r,z reaction rate matrix and flux map through row 8 of the reactor and into the lower blanket. A description of the 50H and 50G tests, the methods of data analyses used by HEDL to interpret the dosimetry data, and the results of the HEDL analysis are presented. The measured reaction rate data which form the basis for the results are attached as an appendix. (auth)

9395 (JABE-WADCO-2(Rev.)) SEISMIC DESIGN CRITERIA FOR THE FAST FLUX TEST FACILITY, RICHLAND, WASHINGTON. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Jun 1973. 56p. Dep. NTIS $5.00.

For Hanford Engineering Development Lab., Richland, WA.

The seismic design criteria are presented for the proposed Fast Flux Test Facility (FFTF) near Richland, Washington. These criteria establish requirements to ensure that structures, systems and equipment are designed in accordance with design standards commensurate with the importance of the safety function which they perform. They apply to Categories I, II, and III Structures, Piping and Equipment. 13 references. (auth)

9396 (JABE-WADCO-3) SEISMIC EVALUATION AND DEVELOPMENT OF GROUND ACCELERATION AND RESPONSE SPECTRA FOR FFTF SITE. A Summary Report. (Blume (John A.) and Associates, Engineers, San Francisco, Calif. (USA)). Feb 1971. 22p. Dep. NTIS $3.25.

For WADCO Corp., Richland, Wash.

A summary of the August 1970 Blume geological report is presented. Additional information concerning the development of the maximum ground acceleration and associated response spectra for the FFTF site is included. The Rattlesnake Wallula fault is

the largest potential earthquake generator near the site. 12 references. (auth)

9397 (JEN-266) CALCULATIONS OF CHANGES IN REACTIVITY DURING SOME REGULAR PERIODS OF OPERATION OF JEN-1 MOD REACTOR. Alcala Ruiz, F. (Junta de Energia Nuclear, Madrid (Spain)). 1973. 56p. (In Spanish). Dep. NTIS (U. S. Sales Only) $5.00.

By a Point-Reactor model and Perturbation Theory, changes in reactivity during some regular operating periods of JEN-1 MOD Reactor have been calculated and compared with available measured values. They were in good agreement. Also changes in reactivity have been calculated during operations at higher power levels than the present one, concluding some practical consequences for the case of increasing the present power of this reactor. (5 references) (auth)

9398 (LA-UR-73-1310) ADSORPTION OF RADIOKRYPTON ON ACTIVATED CHARCOAL IN THE PRESENCE OF HYDROGEN. Fisher, B. B.; Norris, A. E.; Rose, D. G. (Los Alamos Scientific Lab., N. Mex. (USA)). [nd]. 20p. (CONF-730915-4). Dep. NTIS $3.00.

From symposium on noble gases; Las Vegas, Nevada, USA (24 Sep 1973).

The performance of the fixed-bed activated-charcoal trap at the Nuclear Furnace Reactor in removing radioactive krypton and xenon isotopes from the hydrogen propellant is discussed. (auth)

9399 (LFEN-NI.-76-a) PARAMETRIC STUDY OF A COOLING TOWER (COOLING CIRCUIT OF THE RPI). Barros, A. (Junta de Energia Nuclear, Sacavem (Portugal). Lab. de Fisica e Engenharia Nucleares). 1972. 34p. (In Portuguese). Dep. NTIS (U. S. Sales Only) $3.75.

The purpose of the present study is to extrapolate the behavior of the cooling tower in the cooling circuit of the Portuguese research reactor to conditions different from nominal in its vicinity. The water flow, the air flow, and the coefficient of mass transfer of 10% in the tower are varied. The study was made using four computer programs in the Fortran IV language. This made it possible to obtain the inlet and outlet temperatures of the water in the tower as a function of the operating power and the humid temperature of the air. (tr-auth)

9400 (NP-19884) OECD HALDEN REACTOR PROJECT. Thirteenth Annual Report. (Organization for Economic Co-Operation and Development, Paris (France)). 1972. 178p.

Activities in the Halden Reactor Project during 1972 are summarized. The main activities were development of control methods and computer applications, fuel research and test fuel irradiation, and HBWR operations. The administration and finances of the Project are outlined. (JWR)

9401 (ORNL-TM-4399) BULK SHIELDING FACILITY QUARTERLY REPORT: APRIL, MAY, AND JUNE OF 1973. Hurt, S. S. III; Lance, E. D.; Thomas, J. R. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 25p. Dep. NTIS $3.25.

The BSR operated at an average power level of 1,805 kw for 47.11% of the time during April, May, and June. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. The BSR was operated at low and variable power during this quarter for 106.750 hours as part of the training programs for nuclear engineering students from the University of Tennessee and for Tennessee Valley Authority (TVA) personnel from Browns Ferry. The PCA was also used in the above-mentioned training programs and was operated on nine occasions when TVA personnel or University of Tennessee students actively participated in training laboratories. (auth)

9402 (ORNL-TM-4428) BULK SHIELDING FACILITY QUARTERLY REPORT, JULY, AUGUST, AND SEPTEMBER OF 1973. Hurt III, S. S.; Lance, E. D.; Thomas, J. R. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

The BSR operated at an average power level of 1,993 kW for 21.69% of the time during July, August, and September. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. There were no unscheduled shutdowns during the quarter. The PCA was not used during this report period and remains in a secured condition. (auth)

9403 (SJE-129) OPTIMALIZATION OF SHIELDING FOR THE ZRR FAST TESTING REACTOR. Fritz, Z.; Jechort, P.; Valenta, V.; Vlachovsky, K. (Skoda, Plzen (Czechoslovakia)). 1972. 150p. Dep. NTIS (U. S. Sales Only) $9.50.

The optimization of an iron–graphite axial shielding and the composition of concrete forming the radial shielding of the ZRR fast testing reactor are described. The technique of performing the optimization is described. 20 references. (auth)

9404 (SLA-73-551) SANDIA PULSED REACTOR II (SPR II): EXPERIMENTER'S MANUAL. Bonzon, L. L.; Snyder, J. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 42p. Dep. NTIS $4.25.

The operational characteristics and procedures for use of SPR II by experimenters are described. Emphasis is directed toward the user's needs regarding facility access and in estimating total exposure to the experiment. This document replaces the Sandia Laboratories publication SC-M-69-289, "SPR IIA Experimenter's Manual" as the applicable manual for SPR II. 12 references. (auth)

9405 (SLA-73-796) ANALYSIS OF THE STORAGE OF REACTOR FUEL AND OTHER FISSILE MATERIALS IN THE SPR VAULT. Philbin, J. S. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 12p. Dep. NTIS $3.00.

A criticality analysis of fissile material storage in the SPR vault is presented. Storage cell dimensions and unit mass limits are defined and safe storage practices are recommended. Mixed storage of different fissile materials in a single array is also considered. 7 references. (auth)

9406 (SLA-73-812) SANDIA PULSED REACTOR III (SPR III): PREDICTED PERFORMANCE CHARACTERISTICS. Bonzon, L. L.; Reuscher, J. A.; Schmidt, T. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 18p. Dep. NTIS $3.00.

The predicted performance characteristics of the Sandia Pulsed Reactor III (SPR III) are presented. The principal design criteria are to provide an irradiation cavity ~18 cm in diameter and ~40 cm long, and a fluence of 6×10^{14} nvt (near-fission spectrum) neutrons in a single pulse with a width, at half maximum intensity, of less than 60 microseconds. 9 references. (auth)

9407 (SRARI-P-194) EFFECT OF THE FUEL PARTIAL OVERLOADINGS ON THE FUEL CONSUMPTION AND COST IN THE RESEARCH REACTORS. Tsykanov, V. A. (Nauchno-Issledovatel'skij Inst. Atomnykh Reaktorov, Dimitrovgrad (USSR)). 1973. 24p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The effect of the fuel partial overloadings in the high-flux trap-type reactor core on the fuel consumption and appropriate cost is analyzed. It is found that in all cases the optimum nuclear fuel burnup occurs when its consumption and cost are negligible. The expediency is shown of the fuel partial overloadings in the research reactors. (auth)

9408 (TID-26483) KSU TRIGA MK II ANNUAL REPORT, 1972. (Kansas State Univ., Manhattan (USA)). 1973. Contract AT(11-1)-2219. 19p. Dep. NTIS $3.00.

From January 1, 1972, to January 1, 1973, the Kansas State University TRIGA Mark II Nuclear Reactor was operated for a total of 30,860 kilowatt hours. As in past years, the use of the nuclear reactor was directed toward research, production of radionuclides and training. Ninety-five individual users from thirteen departments within Kansas State University and ten departments from other colleges and universities were served. A list of the individual user, the date, and nature of his experiment is presented. All the experimenters are listed by name and the experimentor is identified by institution. (auth)

9409 (WARD-2171-38) FAST FLUX TEST FACILITY QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING AUGUST 31, 1973. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1973. Contract AT(45-1)-2171. 63p. AT.

Research and development activities for the FFTF reactor are reported under the following headings: reactor systems; reactor components; plant systems and instrumentation and control components; plant mechanical components and heat transfer system; safety analysis and review; materials application; and project administration. (JWR)

9410 INTER-UNIVERSITY JOINT USE OF GOVERNMENT NUCLEAR FACILITIES IN JAPAN. III. Nuclear Engineering Research Lab., University of Tokyo. An, S. (Tokyo Univ.). Nippon Genshiryoku Gakkaishi; 14: No. 12, 694-698(Dec 1972). (In Japanese).

The Nuclear Engineering Research Laboratory, belonging to the Faculty of Engineering, was established in 1967; and its main facility, the nuclear reactor "Yayoi" attained criticality in April 1971. Circumstances for its installation, outline of facilities and organization, the reactor and its ancillary equipment, research works planned with the reactor, and current state of joint use are described. The research reactor is a so-called "fast-neutron source," its output is 2 kW, maximum neutron flux is about 0.8×10^{12}, and it was constructed along the line of fast power reactor development in Japan. Other objectives of the facilities in-

clude studies on high-intensity radiation, short-lived isotopes, development of reactors, and education and training. (JA)

Production and Materials Testing and Processing Reactors

Refer also to abstracts 7636, 7645, and 9538.

9411 (AE-478) IRRADIATION FACILITIES FOR LWR FUEL TESTING IN THE STUDSVIK R2 REACTOR. Sandklef, S.; Tomani, H. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Oct 1973. 30p. Dep. NTIS (U. S. Sales Only) $3.50.

Irradiation testing of LWR fuel plays an important role in the development of reliable and economical fuel designs. With the accumulated experience of power reactor operation the need for sophisticated, well defined fuel experiments has increased. At the Studsvik R2 reactor a number of irradiation facilities have been developed to cover this need. The design and functions of these facilities as well as the neutron physics characteristics are described. The use of neutron absorbers as a means of controlling the irradiation conditions has been established in the R2 reactor and some applications are described. 7 references. (auth)

9412 (CEA-N-1605) RADIOACTIVE CONTAMINATION OF A LOOP AFTER THE IRRADIATION OF CARBIDE AND NITRIDE FUELS FOR FAST NEUTRON SODIUM COOLED REACTORS (MFBS 2 LOOP OF THE MOL CENTER). Saroul, J.; Illes, E. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France)). Aug 1973. 31p. (In French). Dep. NTIS (U. S. Sales Only) $3.75.

Following a cladding failure which occurred with fuel in the MFBS2 (Manipulation Franco-Belgian Sodium) irradiation loop, additional measurements were made at Cadarache on the contamination of the loop's primary circuit. These measurements involved a sodium sample taken from the loop drain tank together with several piping samples. The following ratio was determined for ^{134}Cs, ^{137}Cs, ^{154}Eu, and ^{125}Sb: concentration on the wall (μ Ci/cm^2)/concentration in the Na (μ Ci/cm^3). The penetration of the following elements in stainless steel up to a depth of 120 microns was studied: ^{137}Cs, ^{125}Sb, and ^{154}Eu. An order of magnitude value is given for the irradiated fuel emission coefficients of the carbide and nitride for some fission products. 9 references. (FR)

9413 (ORNL-TM-4431) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT JULY, AUGUST, AND SEPTEMBER OF 1973. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

Reactor operation was routine this quarter with an on-stream time of 94.6% which brought the on-stream time for the year up to 93.8%. The semiannual reactor component inspection was completed and the control plates were changed. (auth)

Propulsion and Package Reactors

Refer also to abstracts 8196, 8352, 8419, 9492, 9530, 9531, and 9537.

9414 (AGC-2277(Vol.1)(Bk.2)) RADIATION EFFECTS DATA BOOK. Volume I. Radiation Effects. (Aerojet General Corp., Azusa, Calif. (USA)). 30 Sep 1964. 246p. Dep. NTIS $14.50.

Declassified 28 Aug 1973.

The Radiation Effects Data Book, Volume I, contains a summary of the irradiation tests conducted by Aerojet-General Corporation and Westinghouse Astronuclear Laboratory. The intent of this Data Book is to document the NERVA Radiation Effects Program in such a manner as to present the status of the Radiation Effects test portion of each NERVA component development program. The text includes a description of the NERVA radiation environment for each component tested, a pre-irradiation evaluation of the component relative to anticipated radiation effects, a discussion of the radiation tests performed on the component, and an evaluation of the test results. (auth)

9415 (ANL-7036) NUCLEAR ROCKET PROGRAM QUARTERLY PROGRESS REPORT, DECEMBER 1964-MAY 1965. (Argonne National Lab., Ill. (USA)). May 1965. Contract W-31-109-eng-38. 260p. Dep. NTIS $15.00.

Declassified 28 Aug 1973.

Information is presented concerning the design parameters for a 100,000-pound-thrust refractory metal fast reactor rocket engine; engineering test program; structural mechanics; heat transfer and fluid dynamics; development, fabrication, and evaluation of high temperature cermets; stabilization of UO_2; chemical properties of UO_2; rocket reactor kinetics; and rocket reactor control system. (DCC)

9416 (ANL-7111) NUCLEAR ROCKET PROGRAM QUARTERLY PROGRESS REPORT, THIRD QUARTER, 1965. (Argonne National Lab., Ill. (USA)). 1965. Contract W-31-109-eng-38. 150p. Dep. NTIS $9.50.

Declassified 28 Aug 1973.

Reactor engineering, metallurgy, and chemical engineering research on the development of a refractory-metal fast reactor for rocket propulsion is reported. The emphasis in all areas of research during the quarter was on the development of fuel elements and fuel element systems. (JWR)

9417 (D-910092-5) THEORETICAL EFFECT OF CHANGES IN CONSTITUENT OPACITIES ON RADIANT HEAT TRANSFER IN A VORTEX-STABILIZED GASEOUS NUCLEAR ROCKET. Kesten, A. S.; Kinney, R. B. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). Sep 1965. 58p. Dep. NTIS $5.00.

Declassified 28 Aug 1973.

A theoretical investigation was conducted to determine the effect of changes in constituent opacities on the radiant heat transfer characteristics and temperature distributions in both the hydrogen-propellant and fuel-containment regions of a vortex-stabilized gaseous nuclear rocket. Two changes from preceding calculations were made which influenced primarily the opacities in the propellant region at temperatures between 10,000 and 15,000 R. The first change consisted of adding the opacity contribution of vaporized tungsten seeds whose spectral lines are broadened by the presence of high-pressure hydrogen propellant. The second change consisted of neglecting the opacity due to the Lyman-α line in hydrogen, and was made because of recent experimental information on opacity in the far line wings of monatomic gases. The results of the propellant-region calculations indicate that the inclusion of the opacity of vaporized tungsten seeds resulted in a substantial reduction in the distance required to absorb the incident radiant energy. Temperature distributions in the fuel-containment region were determined for fuel opacities equal to half and twice those which have been employed in preceding calculations, and for opacities which were determined from recent theoretical determinations of fuel ionization potentials. The fuel temperatures near the centerline of the vortex were found to be relatively insensitive to changes in fuel opacity. 14 references. (auth)

9418 (GE-NMP-61-13) PROPOSAL FOR THE STUDY OF THE APPLICATION OF SMALL NUCLEAR ROCKETS TO MANEUVERABLE ORBITAL VEHICLES. (General Electric Co., Cincinnati, Ohio (USA). Nuclear Materials and Propulsion Operation). 24 Aug 1961. 36p. Dep. NTIS $4.00.

Declassified 28 Aug 1973.

The possibility of using a small unmoderated metallic reactor as the propulsion system for maneuverable orbital vehicles is discussed. A comparative evaluation of the performance capabilities of orbital vehicles with chemical and nuclear rockets of 10,000 pounds thrust is performed. A conceptual design for a reactor providing power for a rocket of 10,000 pounds thrust is presented. (JWR)

9419 (GKSS-72/E/28) ZERO-POWER EXPERIMENT WITH THE SECOND CORE OF THE "OTTO HAHN" (FDR II-0). Ablett, M.; Baumgart, R.; Boessow, E.; Boessow, E.; Boettcher, G.; Eck, I.; Guelzow, D.; Guetzlaff, U.; Kolb, M.; Krull, W.; Martens, P.; Robinson, E.; Schwieger, E.; Wrobel, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1972. 139p. (In German). Dep. NTIS (U. S. Sales Only) $9.00.

The zero-power experiments with the 2nd core of the FDR are described: critical experiment, symmetry testing, calibration of the control rods, reactivity measurements (shutdown reactivity, stuck-rod, temperature coefficient, coupling, excess reactivity with boric acid poisoning and pulse measurements, control curves). Importance and thermal flux measurements were done in a fuel element. Furthermore, partial core loads from FDR fuel elements were investigated. Reactivity measurements using the pulse method for reactivity values up to -$45 are discussed. The measured reactivity values are compared with the diffusion calculations. (GE)

9420 (H-910375-5) ANALYTICAL STUDY TO DETERMINE THE CHARACTERISTICS OF NUCLEAR LIGHT BULB MODEL TESTS IN A PEWEE REACTOR. Latham, T. S. (United Aircraft Corp., East Hartford, Conn. (USA). Research Labs.). Sep 1969. Contract NASw-847. 63p. Dep. NTIS $5.25.

Declassified 28 Aug 1973.

An analytical study was conducted to determine the characteristics of a unit-cell model of a nuclear light bulb reactor when this gaseous-nuclear-fueled model is mounted in a modified ver-

sion of Pewee, the solid-core nuclear rocket fuel element test reactor. Three types of tests of increasing complexity were considered: (1) a demonstration that nuclear fuel can be contained fluid dynamically while fissioning in a gaseous cloud; (2) a demonstration that internally-cooled transparent walls can be fabricated and shown capable of withstanding both the nuclear radiation and thermal environments anticipated for a nuclear light bulb engine; and (3) a demonstration that seeded hydrogen propellant can be heated to exhaust temperatures in excess of those presently employed in solid nuclear fuel elements. The results of the analytical study indicate that meaningful in-reactor demonstration tests could be performed in a modified version of the Pewee reactor. In addition, the model could be tested in an r-f induction heater at approximately the same power levels as in the Pewee tests prior to the actual in-reactor tests. 18 references. (auth)

9421 (LA-5398-MS) PERFORMANCE OF (U,Zr)C-GRAPHITE (COMPOSITE) AND OF (U,Zr)C (CARBIDE) FUEL ELEMENTS IN THE NUCLEAR FURNACE 1 TEST REACTOR. Lyon, L. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1973. Contract W-7405-eng-36. 63p. Dep. NTIS $5.45.

The properties of and reactor test results for two types of nuclear-propulsion-reactor fuel elements containing uranium-zirconium carbide, (U,Zr)C, are reported. Composite fuel elements containing graphite and ~35 vol % carbide, along with fuel elements consisting only of carbide, were tested in Los Alamos Scientific Laboratory's Nuclear Furnace 1 reactor for 109 min at peak power densities of ~4500 MW/m^3 and temperature up to 2500°K. Fission-fragment damage to the graphite phase of the composite fuel elements increased the room-temperature thermal resistivity of the matrix ninefold, resulting in unexpected high mass losses of carbon. The carbide elements developed both longitudinal and transverse fractures but did not fragment into small-size particles. (auth)

9422 (N-73-29717) FEASIBILITY OF AN ON-LINE FISSION-GAS-LEAK DETECTION SYSTEM. Lustig, P. H. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). Aug 1973. 16p. (NASA-TM-X-2870; E-7007). NTIS $3.00.

Calculations were made to determine if a cladding failure could be detected in a 100-kW zirconium hydride reactor primary system by monitoring the highly radioactive NaK coolant for the presence of ^{131}I. The system is to be completely sealed. A leak of 0.01% from a single fuel pin was postulated. The 0.364-MeV gamma of ^{131}I could be monitored on an almost continuous basis, while its presence could be varified by using a longer counting time for the 0.638-MeV gamma. A lithium-drifted germanium detector would eliminate radioactive corrosion product interference that could occur with a sodium iodide scintillation detector. (auth)

9423 (PWAC-308) APPLICATION OF A FAST REACTOR CONCEPT TO ROCKET PROPULSION, JUNE 15, 1960. Muller, G. L. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 9 Sep 1960. Contract AT(11-1)-229. 95p. Dep. NTIS $6.75.

Declassified 29 Aug 1973.

The application of fast-fission-spectrum reactors to rocket propulsion is described. The analysis covers a range of reactor core powers from 10 to 10,000 Mw, maximum fuel element centerline temperatures of 4500 to 5000°F, and mean fuel-element-centerline-to-bulk-gas temperature differences of 200, 500, and 800°F. The basic reactor had 50 volume percent tungsten–50 volume percent urania fuel plates separated by channels for the hydrogen coolant, and a beryllium reflector of such thickness as to give the minimum radial variation in core power density. The core exit hydrogen Mach number and core exit chamber pressure were optimized for minimum power plant weight. The turbopump weight was included in the power plant weight. The reactor power range was chosen to include missions starting from an orbit where the thrust may be smaller than the vehicle gross weight, and ground launching where, or course, the thrust is larger than the vehicle gross weight. The maximum fuel element centerline temperatures and centerline-bulk-gas temperature differences were varied since the high-temperature strength of the tungsten–urania fuel elements is unknown. These variables would, of course, be fixed by strength limitations. Some limited studies on application to space propulsion showed that the nuclear propulsion system could carry a heavier payload than a hydrogen-fluorine propulsion system for vehicle gross weights greater than about 5000 pounds for acceleration from a 400-mile-altitude orbit to an Earth–Mars minimum-energy transfer orbit using a 50 Mw reactor with a 5000°F maximum temperature and an 800°F element-centerline-bulk-gas temperature difference. 23 references. (auth)

9424 (RN-TM-365) RADIATION ANALYSIS FOR NON-NUCLEAR COMPONENTS OF THE NERVA DEVELOPMENT ENGINE NRX-A6 REACTOR TEST. Warman, E. A.; Garrington, G. (Aerojet-General Corp., Sacramento, Calif. (USA)). 1 Feb 1967. 77p. Dep. NTIS $6.00.

Declassified 29 Aug 1973.

Extensive radiation analyses have been completed to determine the radiation heating and neutron and gamma radiation intensities in the non-nuclear portions of the NRX-A6 NERVA development engine reactor test. The results of these analyses are presented along with a discussion of the calculational methods employed and the analytical models and radiation sources. (auth)

9425 (TID-26044) COMMON ANALOG MODEL DERIVATION (POWER RANGE). Engineering Operations Report. Miller, J. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). May 1972. 155p. Dep. NTIS $9.75.

Declassified 30 Aug 1973.

The E-1 CAM (Common Analog Model) is a joint ANSC-WANL effort to describe the dynamic behavior of the NERVA engine in the power range (above 50 psi/1250°R). The derivation of the ANSC non-nuclear portion of Revision 7 of the E-1 CAM (there is no corresponding derivation of the nuclear portion) is presented. The model itself is given as an appendix. Revision 7 represents (1) an update to the 400E engine configuration and (2) a more detailed description of hydrogen properties and certain engine components consistent with the maturity of the design and the addition of high speed digital function processing to the ANSC hybrid computer. While a preliminary version of the nuclear subsystem was digitally mechanized (at WANL), the support system is the only portion of the final model to be mechanized on a hybrid computer (at ANSC). (20 references) (auth)

9426 (TID-26081) NERVA STARTUP COMMON ANALOG MODEL EQUATION DERIVATIONS. Dryden, R. M. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Jun 1972. 201p. Dep. NTIS $12.25.

Declassified 30 Aug 1973.

The derivations of the equations used in the ANSC portion of the Start-Up CAM are presented. The derivations consist of the basic equation, the equation with the start-up model subscripts, the variable identified along with units, the assumption that was made to generate the particular equation, and background information if needed. Only the ANSC portion of the Start-Up CAM is included. (auth)

9427 (UCID-4114) RADIATION HEATING OF SOME COMPONENTS NEAR THE TORY IIA CORE. Lorenz, A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1959. 5p. Dep. NTIS $3.00.

Declassified 18 Oct 1971.

Radiation heating of the shroud and aluminum pressure vessel at the core median plane and the materials at the forward and aft flanges was evaluated. The results are presented and discussed. (JWR)

9428 (WANL-TME-481) TEMPERATURE TRANSDUCERS FOR NRX. Murray, T. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). 2 Sep 1963. Contract AT(30-1)-3108. 68p. Dep. NTIS $5.50.

Declassified 29 Aug 1973.

Three types of thermocouples are required to cover the range of temperatures from 35°R to 4680°R now specified for NRX-A1 and NRX-A2. Copper-constantan is used for the lower temperature range from about 35°R to about 600°R, chromel–alumel from about 600°R to about 2500°R, and the tungsten/tungsten-26% rhenium from about 2500°R to about 4860°R. The physical configurations mostly specified for these couples are shown. This swaged, metal-sheathed type of thermocouple has been used in the KIWI tests and has in general performed satisfactorily. The use of all metal and inorganic construction is required for hot tests, due to the high levels of radiation involved. Detailed military type specifications have been written for all thermocouples specified for NRX tests. These specifications have made use of the existing MIL-22300 specification on thermocouples and the original LASL specifications for KIWI tests, which have been revised and expanded upon as considered appropriate to our application. The specifications cover requirements for the wire, insulation, and sheath material used in the thermocouple, methods of fabrication, calibration, and acceptance testing. These specifications are enforced by WANL inspectors at the place of manufacture, and by inspection after reception at WANL. 9 references. (auth)

9429 (WANL-TME-582) HIGH TEMPERATURE THERMOCOUPLES FOR NRX. Murray, T. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Nov 1963. Contract AT(30-1)-3180. 38p. Dep. NTIS $4.00.

Declassified 29 Aug 1973.

Molybdenum-sheathed thermocouples with an added protective tube of tungsten-coated tantalum have survived a high temperature run of 30 minutes over 4500°R, with peak temperatures of about

4900°R, followed by a 90 minute shaker test at 5 to 10 g's, followed by a second high temperature run of 30 minutes over 4500°R, with peak temperatures of about 4900°R. Molybdenum-sheathed thermocouples with an added protective tube of tantalum pre-treated to form carbide to a depth of 0.0005 in. to 0.001 in. have survived two temperature cycles similar to those described above. These have not yet been vibration tested. Molybdenum sheaths used as the external sheath in contact with graphite continue to give unsatisfactory results even when coated with tungsten, or tungsten carbide. Tungsten–26% rhenium sheath material cannot be relied on to more than about 4500°R in contact with graphite, and is not appreciably better than molybdenum. Thorium oxide insulation, in an 0.066 in. OD thermocouple, will not allow temperatures higher than about 4600°R to be read, because of its rapid decrease in resistance with temperature. Thorium–oxide insulated thermocouples tested showed erratic performance even at relatively low temperatures. (auth)

9430 (WANL-TME-703) RADIOACTIVE LEVEL OF SMALL PARTICLES RESULTING FROM OPERATION AND DESTRUCT OF THE NERVA REACTOR CORE. Bridges, J. M.; Trammell, M. R.; Brown, W. S. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Feb 1964. Contract SNP-1. 34p. Dep. NTIS $3.75.

Declassified 29 Aug 1973.

On the safety problems associated with the post-operational destruction of a NERVA engine following flight operation involves the re-entry of small core fragments (110 μ to 1000 μ diameter particles) to the earth's biosphere. These particles are of particular biological significance since they are small enough to be ingestible, but large enough to give (possibly) an appreciable internal dose. Assessment of the radioactive level of particles in this size range is presented. 6 references. (auth)

9431 (WANL-TME-1375) SINGLE CLUSTER CORROSION TEST SUMMARY, AUGUST 1965 TO MARCH 1966. Salvador, L. A.; Foster, R. D.; Wagner, L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Astronuclear Lab.). Apr 1966. Contract SNP-1. 125p. Dep. NTIS $8.25.

Declassified 29 Aug 1973.

Accomplishments on the HHT-4 Cluster Corrosion Test from September 1965 to March 1966 are described. The development of hardware, techniques, and procedures to upgrade the state-of-the-art of high temperature corrosion testing of complete clusters is discussed. In addition, testing of support block and components designs in support of NRX-A4 and NRX-A5 designs using the cluster test is reviewed. 5 references. (auth)

Reactor Safety and Environmental Aspects

Refer also to abstracts 7701, 9306, 9543, 9546, and 9609.

9432 (AEC-tr-7483) NUCLEAR REACTOR SITING GUIDELINES AND CRITERIA FOR THEIR APPLICATION. (Atomic Energy Commission, Tokyo (Japan)). 27 May 1964. Translated from Japanese. 10p. Dep. NTIS $3.00.

9433 (AEC-tr-7497) METEOROLOGICAL GUIDELINES FOR THE SAFETY ANALYSIS OF NUCLEAR REACTORS. 2 Nov 1965. Translation of Report of the Nuclear Reactor Safety Standards Sub-Committee to the Atomic Energy Commission, Tokyo, Japan. 60p. Dep. NTIS $5.00.

9434 (BAW-1390) THREE MILE ISLAND UNIT 1 FUEL DENSIFICATION REPORT. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Sep 1973. 58p.

In June of 1973, Babcock & Wilcox filed topical report BAW-10055, Rev. 1, "Fuel Densification Report," which describes the methods to be used in analyzing fuel densification effects in accordance with the guidelines set forth in the AEC report, "Technical Report on Densification of Light Water Reactor Fuels," dated November 14, 1972. An analysis of the effects of fuel densification on the fuel for Three Mile Island Unit 1 is presented. The safe operation of that Unit at the rated core power level of 2535 MW(t) is supported. (auth)

9435 (BAW-1392) ARKANSAS NUCLEAR ONE, UNIT 1 FUEL DENSIFICATION REPORT. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Sep 1973. 59p.

In June of 1973, Babcock & Wilcox filed proprietary topical report BAW-10055, Rev. 1, "Fuel Densification Report," which describes the methods to be used in analyzing fuel densification effects in accordance with the guidelines set forth in the AEC report, "Technical Report on Densification of Light Water Reactor Fuels," dated November 14, 1972. An analysis of the effects of fuel densification on the fuel for Arkansas Nuclear One Unit 1 is presented. The safe operation of that Unit at the rated core power level of 2568 MW(t) is supported. (auth)

9436 (BAW-1394) RANCHO SECO UNIT 1 FUEL DENSIFICATION REPORT. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Sep 1973. 56p.

In June of 1973, Babcock & Wilcox filed topical report BAW-10055, Rev. 1, "Fuel Densification Report," which describes the methods to be used in analyzing fuel densification effects in accordance with the guidelines set forth in the AEC report, "Technical Report on Densification of Light Water Reactor Fuels," dated November 14, 1972. An analysis of the effects of fuel densification on the fuel for Rancho Seco Unit 1 (RS-1) is presented. The safe operation of that Unit at the rated core power level of 2772 MW(t) is supported. (auth)

9437 (BAW-1396) OCONEE 2 FUEL DENSIFICATION REPORT. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Sep 1973. 59p.

In June of 1973, Babcock & Wilcox filed topical report BAW-10055, Rev. 1, "Fuel Densification Report," which describes the methods to be used in analyzing fuel densification effects in accordance with the guidelines set forth in the AEC report, "Technical Report on Densification of Light Water Reactor Fuels," dated November 14, 1972. An analysis of the effects of fuel densification on the fuel for Oconee 2 is presented. The safe operation of that Unit at the rated core power level of 2568 MW(t) is supported. (auth)

9438 (BAW-1398) CRYSTAL RIVER UNIT 3 FUEL DENSIFICATION REPORT. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Oct 1973. 58p.

In June of 1973, Babcock & Wilcox filed topical report BAW-10055, Rev. 1, "Fuel Densification Report," which describes the methods to be used in analyzing fuel densification effects in accordance with guidelines set forth in the AEC report, "Technical Report on Densification of Light Water Reactor Fuels," dated November 14, 1972. An analysis of the effects of fuel densification on the fuel for Crystal River Unit 3 is presented. The safe operation of that Unit at the rated core power level of 2452 MW(t) is supported. (auth)

9439 (BAW-10062) MULTINODE ANALYSIS OF SMALL BREAKS FOR B AND W's 145-FUEL-ASSEMBLY NUCLEAR PLANTS WITH INTERNALS VENT VALVES. Parks, C. E.; Allen, R. J.; Cartin, L. R. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Oct 1973. 47p.

Multinode analyses were conducted for several small breaks in the reactor coolant system of B&W's 145 fuel-assembly nuclear plants with internals vent valves. The multinode blowdown code CRAFT was used to evaluate the hydrodynamics and transient water inventories of the reactor coolant system. The FOAM code was used to compute a swell level history for the core, and the THETA 1-B code was used to perform transient fuel pin thermal calculations. Curves showing the parameters of interest are presented. These results are well within the Atomic Energy Commission's Interim Acceptance Criteria. 4 references. (auth)

9440 (BAW-10065(Suppl. 1)) MULTINODE ANALYSIS OF B AND W's 205-FUEL-ASSEMBLY (MARK-C DESIGN) NUCLEAR PLANT DURING A LOSS-OF-COOLANT ACCIDENT. Parks, C. E.; Dunn, B. M.; Jones, R. C. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Nuclear Power Generation Div.). Aug 1973. 34p.

A multinode analysis was conducted to evaluate the worst loss-of-coolant accident for B&W's nuclear plants with internals vent valves and 205 Mark-C assemblies. The multinode blowdown code CRAFT, the re-flooding code REFLOOD, and the cladding heatup code THETA1-B, were used to perform the analysis at a core power of 3760 MW(t). Curves showing the parameters of interest are presented. Results of the analysis indicate that the emergency core cooling system will terminate the cladding temperature transient and limit the course of the LOCA in accordance with the AEC Interim Policy Statement. 5 references. (auth)

9441 (CONF-721006-P1) ENGINEERING OF FAST REACTORS FOR SAFE AND RELIABLE OPERATION. Volume I. Proceedings, International Conference, Karlsruhe, October 9–13, 1972. Faude, D. (ed.). (Bundesministerium fuer Forschung und Technologie, Bonn (F.R. Germany); Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany); Kerntechnische Gesellschaft im Deutschen Atomforum e.V., Bonn (F.R. Germany)). 1973. 485p. (In several languages). Nuclear Research Center, Karlsruhe, Ger.

Separate abstracts are included for 6 of the 23 papers presented concerning engineering practices and engineered safeguards for fast reactors. Seventeen of the papers have been previously indexed and included in NSA. The seventeen papers may be located in the Report Number Index of NSA under the following: CONF-721006-P1. (DCC)

For abstracts of individual papers see: 9347–9350, 9383, and 9532.

9442 (CONF-721006-P2) ENGINEERING OF FAST REACTORS FOR SAFE AND RELIABLE OPERATION. Volume II. Proceedings, International Conference, Karlsruhe, October 9–13, 1972. Faude, D. (ed.). (Bundesministerium fuer Forschung und Technologie, Bonn (F.R. Germany); Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany); Kerntechnische Gesellschaft im Deutschen Atomforum e.V., Bonn (F.R. Germany)). 1973. 523p. (In several languages). Nuclear Research Center, Karlsruhe, Ger.

Separate abstracts are included for 23 of the 26 papers presented concerning operational experience and safety approaches; and fuel failure, sodium boiling, and fuel–sodium interaction. Three of the papers have been previously indexed and included in NSA. The three papers may be located in the Report Number Index of NSA under the following: TRG-Report-2366; JPRS-57675; and HEDL-SA-393. (DCC)

For abstracts of individual papers see: 9337, 9351, 9352, 9384, 9385, and 9443–9460.

9443 (CONF-721006-P2, pp 564-581) SAFETY APPROACH IN THE WESTINGHOUSE LMFBR. Strawbridge, L. E.; Graham, J.; Zoubek, J. A. (Westinghouse Advanced Reactors Div., Madison, PA). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The safety related design features of the Westinghouse LMFBR are described and the design and evaluation approach used to assure safety is discussed. The design emphasizes three safety related objectives: reliable operation; plant protection; and additional margin through engineered safety features. These objectives are met by applying safety related design criteria to assure reliable operation and reduce the consequences of faults that might occur despite precautions taken in design, construction, and operation of the plant. Postulated faults are classified according to their expected frequency of occurrence, and design limits are established which relate the allowed damage to the expected frequency. The consequences of the more probable faults are limited to minor core damage, while the consequences of the extremely improbable or hypothetical accidents are limited to remain within the siting criteria of the United States Atomic Energy Commission. Postulated faults are surveyed and the design provisions to prevent the accidents or mitigate the consequences are discussed. 18 references. (auth)

9444 (CONF-721006-P2, pp 582-602) SAFETY AND RELIABILITY CONSIDERATIONS IN CORE DESIGN. Pluta, P. R.; Greebler, P.; Hikido, K.; Hines, D. P.; Olich, E. E. (General Electric Co., Sunnyvale, CA). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Safety and reliability considerations have played a strong role in the design of the General Electric Demonstration Plant core. The design parameters selected for this core and expected performance characteristics are presented. Full advantage is being taken of the base technology being developed for the U. S. Fast Test Reactor. (auth)

9445 (CONF-721006-P2, pp 605-625) BEHAVIOR OF FAILED FUEL. Craig, C. N. (General Electric Co., Sunnyvale, CA); Regimbal, J. J.; Novak, P. E.; Aitken, E. A.; Baily, W. E.; Rubenstein, L. S. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Random fuel rod failures resulting in loss of hermeticity of the fuel rod clad are expected for fuel operating at economic conditions, in liquid metal fast breeder reactors. Two aspects of the problem related to design and operation with defective fuel are discussed: the rate and influence of swelling of a failed fuel rod and the consequences of continued operation with failed fuel. Results of experiments are presented and discussed for each area. The discussion includes the identification of areas requiring further testing and evaluation. 13 references. (auth)

9446 (CONF-721006-P2, pp 643-671) EXPERIMENTAL STUDY OF ELEMENT BEHAVIOR UNDER ACCIDENT CONDITIONS. Roche, L.; Vidal, H. (CEN, Saclay, France). 1973. (In French).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The behavior, under accident conditions, of sodium cooled fast reactor fuel elements is being studied in the three following steps: behavior and destruction of a single pin; behavior of a bundle and destruction propagation between the pins; and destruction propagation between sub-assemblies with fresh or irradiated UO_2 or UO_2–PuO_2 fuel elements. The main types of accidents being studied are: local blockage; total blockage of a sub-assembly; and coolant flow reduction simulating a pump failure. Other special tests are considered: leaking pin behavior; gas injection in a sub-channel; and rupture of a fuel wrapping wire. 4 references. (auth)

9447 (CONF-721006-P2, pp 692-712) SIMULATION EXPERIMENT OF LOCAL FUEL FAILURE AND ITS PROPAGATION. Kondo, S. (Tokyo Univ.); Shimotono, H.; Togo, Y.; An, S.; Tezuka, M. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The importance of accidental flow blockage in fast reactor safety does depend upon the possibility of fuel failure propagation due to it. To investigate this possibility, transient behavior of fuel pin bundle was studied by the simulation experiments using single-rod and seven-rod test section placed in water circulation system. These rods were stainless steel clad lead pins and were electrically heated. The length of heated section was 50 cm and pin diameter was 6.3 mm. The heat rating was varied around 150 W/cm. Three types of transient were considered, overpower, flow coastdown and local flow blockage. Local blockage condition was provided by inserting obstacles in subchannel. Flow rate, temperature and pressure of coolant and acoustic noise were measured in each case. Results are presented. 6 references. (auth)

9448 (CONF-721006-P2, pp 713-729) THEORETICAL STUDIES RELATED TO LOCAL BLOCKAGES IN FAST REACTOR SUBASSEMBLIES. Blake, J. P. H. (Atomic Energy Establishment, Winfrith, Eng.); Gregory, C. V.; Herbert, R.; Smith, D. C. G. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The effect of a local blockage in a fast reactor subassembly has been analyzed by three complementary methods. Thermal conduction theory is used to describe the temperature profiles within the blockage, fuel pin and entrapped coolant. The boundary conditions are provided from the predicted bulk coolant behavior. The macroscopic conditions, temperature and flow profile, in the bulk coolant flow about a blockage of several subchannels are calculated using the HAMBO/SAMBA codes. The blockage is represented purely as a local resistance to flow but the method enables an approximate representation of the multipin geometry. The detailed nature of the downstream wake region has been calculated using the methods developed by Spalding et al. At present these calculations, with the wake code, take no account of multipin geometry, but a possible means whereby this can be accomplished will be discussed. A 3rd code capable of tackling this problem (SABRE) is now under test and is briefly described. Complementary conduction calculations utilizing residence time data for the mean vortex temperature have been performed and are reported. Results, relevant to a current fast reactor design, from all three methods are presented. The shortcomings and advantages of each method are outlined. 9 references. (auth)

9449 (CONF-721006-P2, pp 730-741) LOCAL BOILING IN A PARTIALLY BLOCKED LMFBR SUBASSEMBLY. Gast, K.; Schleisiek, K. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

In a sodium-cooled breeder reactor local coolant disturbances originating within a fuel rod bundle can result in localized "subcooled" sodium boiling. Local boiling could conceivably initiate a rapid growth of the disturbance, due to the hydrodynamic of the coolant flow or to pin failure propagation. As a first step in a theoretical and experimental program dealing with this problem, an approximate analytical model of the boiling process has been developed. The basic assumptions of this model are discussed. The essential results of the analysis are presented. (auth)

9450 (CONF-721006-P2, pp 742-762) SODIUM EJECTION IN THE TRANSITION REGIME POWER REDISTRIBUTION: EXPERIMENTS AND CALCULATIONS. Costa, J. (CEN, Grenoble, France); Lafay, J.; Rousseau, J. C.; Schmitt, F. 1973. (In French).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The results of sodium ejection experiments under forced convection are given. The test section with one heated pin simulates sufficiently well the power, pressure, velocity, temperature, and flow in a fast reactor subassembly. In the experiments, the power is held constant. By means of valves located in the main circuit of the loop a decrease of the pump pressure is simulated up to the moment where the operation point reaches the minimum point of the internal characteristic of the canal; in our case, it is the power redistribution which is accompanied by oscillations. During these oscillations a periodic draining of the canal comes about. The experiment is stopped when the clad temperature of the heater rod exceeds 1100°C. The results obtained with sodium are compared to results obtained in a water loop operating at sub-atmospheric pressure (in order to have the same expansion as in the case of sodium). On the other hand, the results of numerical calculations with the code FLINA (derived from FLICA (2)) are presented and compared with the experimental results. This code describes a two-phase flow in the permanent and the transition region, comprising the critical power phenomena. The main adjustable parameters are: the non-equilibrium coefficient between liquid and vapor; and the friction between the phases. 6 references. (auth)

9451 (CONF-721006-P2, pp 763-786) EXPERIMENTAL STUDIES OF LIQUID-METAL FAST-REACTOR ACCIDENT CONDITIONS. Marchaterre, J. F.; Fauske, H. K.; Baker, L.; Dickerman, C. E.; Wright, R. W. (Argonne National Lab., IL). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Early studies of LMFBR accidents concentrated on predicting the effects of core compaction and thus, on an understanding of the disassembly process. This stage of accident studies was followed by an attempt to provide a mechanistic description of accident sequences in order to characterize the effects of various accidents more realistically. Substantial effort has been made in experimental studies which contribute to this understanding, including studies in the areas of Coolant Dynamics, Fuel Dynamics, Fuel-failure Propagation, Fuel-Coolant Interactions, and Postaccident Heat Removal. 34 references. (auth)

9452 (CONF-721006-P2, pp 787-811) STUDIES AND EXPERIMENTS ON CORE SAFETY PERFORMED AT USTS (CNEN). Pinchera, G. C.; Martini, M.; Tomassetti, G. (CNEN, Rome). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Sodium boiling, sodium-fuel interaction, fuel-element testing with electrically-heated partial mock-ups; ENAFUSPEC thermal-hydraulic code, and the development of electrically-heated instrumented simulated fuel bundles are discussed. Sodium-boiling forced convection experiments, carried out on single-rod test sections, are reported (0,2–3 m/sec; 30 + 300 W/cm^2; pressures up to 1.8 bar). Liquid velocity, heat flux and saturation temperature have been investigated for their effect on boiling inception and transient two-phase flow regimes. Out-of-pile experiments on sodium-fuel interaction, which make use of UO_2 Joule-effect heating technique, are described together with other minor tests. A thermalhydraulic code to study the dynamic behavior of a sodium-cooled fuel element is described. The technological achievements reached so far at USTS on the development of instrumented, electrically-heated bundles of simulated fuel rods are reviewed. 31 references. (auth)

9453 (CONF-721006-P2, pp 839-851) THERMAL INTERACTION BETWEEN MOLTEN ALUMINA AND LIQUID SODIUM. Pottinger, R. C.; Rees, N. J. M.; Turner, R. G. (United Kingdom Atomic Energy Authority, Foulness, Eng.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

A number of experiments have been carried out dispersing molten alumina at 3000°C in sodium at 250°C and also in cold water. The molten alumina is produced by burning a pyrotechnic charge contained within a weakened cast iron container which has been inserted into a vessel of liquid sodium by a hydraulic ram. The sodium vessel is a cylinder of 408 mm internal diameter and 408 mm deep, with an argon filled space of 27 mm depth (3.7 litres) below the lid. Dynamic measurements of pressure have been made within the charge container, at the base of the sodium vessel, and in the gas space above the sodium. The total energy released by burning the charge is 150 KJ; the charge container bursts at a pressure of 6 MN/m^2, the products being dispersed in the liquid sodium. Pressures of up to 1.2 MN/m^2 have been measured in the gas space with one measurement of 4.6 MN/m^2 probably being caused by sodium impact on the gauge surface; peak pressures in the sodium were about 2 MN/m^2 in terms of the work done comprising the argon. This represents an energy transfer to the coolant of less than 0.4%. Some materials improvement work and a series of charge investigation and development firings are being carried out, since the pyrotechnic as presently manufactured contains contaminating permanent gas of about 10 ml at (NTP) per gram of mixture, instead of the 2 ml/g required to give a gas content equivalent to the gaseous fission products typically present in reactor fuel. (auth)

9454 (CONF-721006-P2, pp 870-883) STUDIES OF PRESSURE GENERATION BY WATER IMPACT UPON MOLTEN ALUMINUM WITH REFERENCE TO FAST REACTOR SUB-ASSEMBLY ACCIDENTS. Hoskin, N. E.; Morgan, K. (Atomic Weapons Research Establishment, Aldermaston, Eng.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

An analytical model of thermal interaction combined with compressible hydrodynamics has been developed and can be shown to produce results which follow accurately the experimental (shock-tube) pressure-time data for the interaction of water with molten aluminium and lead by suitable choice of the parameters, including a time dependent energy transfer. The model of the interaction zone consists of a mixture of molten metal, water and steam. Because of the rapid rate of energy transfer necessary to produce the measured rise times of the pressure pulses the coolant in the interaction zone is divided into two components one of which remains unheated water while the other receives energy from the molten metal and can vaporize. The molten metal is assumed to be incompressible and the heated and unheated components of the coolant are maintained locally in pressure equilibrium. As the model is one dimensional, uniformity of conditions is assumed across the interaction zone but the mass fractions of the components can vary with distance through the interaction zone. The model has been used to analyze the interaction process and plausible assumptions have been used to calculate pressures arising from the interaction of sodium with UO_2 in a fast reactor. 11 references. (auth)

9455 (CONF-721006-P2, pp 884-897) FUEL-COOLANT INTERACTIONS. Jakeman, D.; Potter, R. (Atomic Energy Establishment, Winfrith, Eng.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

A review of the main experimental results available to date is presented. This will highlight any general factors which influence the process and any features which must be satisfactorily explained by any theories. The key area of uncertainty is considered to be the mechanism for dispersing the materials finely enough to permit explosive heat transfer and volume expansion. Some possible explanations are considered and, in particular, a model involving vapor bubble collapse, as occurs in cavitation damage, is examined. This has the attraction of being localized in effect but capable of being unstable and propagating through the whole interacting zone on a short timescale. Some estimates are included of the pressure pulses possible with sodium/UO_2 and comparisons are made with metal/water interactions. 42 references. (auth)

9456 (CONF-721006-P2, pp 898-915) THERMAL INTERACTION BETWEEN WATER AND MOLTEN ALUMINIUM UNDER IMPACT CONDITIONS IN A STRONG TUBE. Darby, K.; Pottinger, R. C.; Rees, N. J. M.; Turner, R. G. (United Kingdom Atomic Energy Authority, Foulness, Eng.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

A number of experiments have been performed in a strong tube to study the impact of cold water on molten aluminium under carefully controlled, repeatable conditions. The tube is superficially similar to that used by Wright and Zivi, although there are many differences of detail. The 84 cm column of water is supported in the 2.5 cm diameter polished bore tube by a stretched rubber diaphragm. The aluminium is melted in a stainless steel crucible using RF heating, the temperature being measured by a thermocouple welded in the base. Cold tests using a quartz tube in place of the Crubee crucible have enabled framing camera photographs of the falling water surface to be taken so that the conditions for a plane water front at first impact are well understood. The transient pressures propagated up the tube from the interaction zone in the crucible are measured using Piezo-electric transducers, and the signals recorded using an FM tape system. The pressure pulses produced by a series of experiments at an aluminium temperature of 720°C and water at 20°C have usually

produced maximum pressures on the second bounce impact of the series in each experiment, the highest pressure being about MN/m². The most finely divided aluminium debris was found after the experiments showing the highest pressure pulses, the surface area and the size distribution of the dispersed aluminium had been measured. The inhibiting effect on the interaction of small permanent gas concentrations in the space between the support diaphragm and the molten aluminium has been demonstrated. A theoretical analysis of the pressure pulses produced has been carried out and the small pressure variations occurring after the steep high pressure rise have been demonstrated to be possibly due to small variations of heat exchange rate in the interaction zone. To help with this theoretical work a viewing cell using a transparent quartz tube supported by gas pressurized pre-stressing is being designed so that the interaction process can be photographed for a wide range of conditions together with time correlated pressure measurements. (auth)

9457 (CONF-721006-P2, pp 916-935) FUEL-COOLANT INTERACTION EXPERIMENTAL AND ANALYTICAL STUDIES RELATED TO FAST REACTORS. Amblard, M.; Syrmalenios, P.; Costa, J. (CEN, Grenoble, France). 1973. (In French).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Following a cooling failure or a reactivity accident the fuel material of a liquid metal cooled fast breeder reactor may come into contact with the coolant. At the initial stage of the interaction the coolant may be liquid or vapor and the fuel may be solid, liquid or vapor. Those different physical states and the different initial conditions (velocity, mass, temperature, pressure of gas or of molten structures, etc.) lead to different forms of interactions. Two experiments are being conducted in which the quantities of UO_2 are very different: JEF in which a pellet of UO_2 surrounded by a stainless steel clad and a gap of sodium is molten by the Joule effect; and CORECT where 6 kg of UO_2 are molten by H.F. and interact (in a first stage) with small quantities of liquid sodium. In both cases the temperatures and pressures in the interaction zone are measured and an analysis of the debris is made, and for JEF the mechanical work and the electrical energy input are measured. In addition a computer code, CORFOU, is being developed. The main phenomena encountered in fuel coolant interactions are described: fragmentation, heating, vaporization and condensation of sodium, mass and heat exchange between the interaction zone and the surroundings etc. This computer code is used to study the influence of several parameters in the general case, in order to get a better understanding of the experimental results. 5 references. (auth)

9458 (CONF-721006-P2, pp 936-951) CALCULATION OF THE PRESSURE HISTORY AND THE PRODUCTION OF KINETIC ENERGY DURING A FUEL-SODIUM-INTERACTION BY SOLVING THE EXACT THERMOHYDRODYNAMIC EQUATIONS. Jacobs, H.; Thurnay, K. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

A model for the fuel-sodium interaction is presented in which the sodium is treated as a heat-conducting compressible liquid. The governing exact thermohydrodynamic equations are solved numerically. The model is used to study the influence of the temperature gradient within the heated sodium on the transferred heat energy, the peak pressures, and the production of kinetic energy. It is shown that—compared to our model—a model using a constant mass of sodium that is heated uniformly is able to give almost correct peak pressures, provided that the amount of heated sodium is properly chosen. But at the same time the transferred heat energy and the produced kinetic energy are grossly overestimated. It is concluded that within a model for the fuel-sodium interaction it is a conservative procedure to assume a fixed mass of interacting sodium. 13 references. (auth)

9459 (CONF-721006-P2, pp 952-966) THEORETICAL MODELS FOR THE MOLTEN FUEL-SODIUM INTERACTION. Caldarola, L.; Koutsouvelis, G. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

A first theoretical model for the fuel sodium reaction was developed at Karlsruhe. This model postulates an instantaneous fuel fragmentation and mixing with sodium, and has been now improved by including better data for the sodium material properties and a modified energy balance equation for the sodium. Numerical evaluations for the German SNR reactor are also shown. A second theoretical model is being developed. This model takes into account reacting masses of fuel and sodium which change with time. It is obvious that the whole mass of fuel does not come in intimate contact with the sodium from the very beginning of the reaction. Models are being considered to describe the fuel fragmentation. These models are based on the assumption that the violent boiling of sodium is either the main cause of fuel fragmentation, or that it is only the triggering mechanism which initiates fuel fragmentation. To consider a finite mixing rate between the fuel and the sodium seems to be important, because the magnitude of the conversion factor from thermal to mechanical energy may be strongly dependent upon this mixing rate. In order to take into account this finite mixing rate, it has been postulated that each fuel particle is characterized by the time at which it begins to participate in the reaction. The fundamental equations governing this second model are described. 8 references. (auth)

9460 (CONF-721006-P2, pp 967-988) EVALUATION OF FUEL COOLANT INTERACTIONS ON KINETICS DURING FAST REACTOR DISASSEMBLY ACCIDENTS. Mills, J. C.; Kastenberg, W. E. (Univ. of California, Los Angeles). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The effects of fuel-coolant interactions on kinetics during fast reactor transients are analyzed. These transients are assumed initiated by a slow ramp reactivity insertion above prompt critical (fuel failure propagation in the central subassemblies) or a large ramp (caused by local sodium voiding). A temperature threshold is used to initiate a fuel-coolant interaction in any node. This is followed by heat-transfer, pressure generation in that channel, sodium expulsion and fuel movement caused by vapor drag. The kinetics are represented by a few group, one dimensional model derived from a synthesis scheme modeling the multigroup, two dimensional equations. The scheme correctly accounts for the space dependent effects caused by Doppler feedback, sodium expulsion and fuel movement. The present study is comprised of two parts. In the first a comparison of space-time and point kinetics is made. The point kinetics model underestimates the coolant feedback early in the transient and overestimates the fuel movement late in the transient. The second part of the analysis is a study of the fuel-coolant dynamics and its effects during the transient. The major parameters in order of importance were found to be (1) fuel particle size, (2) ramp rate, (3) failure threshold temperature, (4) fraction of fuel mixed. The results indicate that a meaningful picture and understanding of the dynamics of fuel-coolant interactions can be obtained with an economical but accurate space-time kinetics model. 27 references. (auth)

9461 (CONF-721006-P3) ENGINEERING OF FAST REACTORS FOR SAFE AND RELIABLE OPERATION. Volume III. Proceedings, International Conference, Karlsruhe, October 9–13, 1972. Faude, D. (ed.). (Bundesministerium fuer Forschung und Technologie, Bonn (F.R. Germany); Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany); Kerntechnische Gesellschaft im Deutschen Atomforum e.V., Bonn (F.R. Germany)). 1973. 501p. (In several languages). Nuclear Research Center, Karlsruhe, Ger.

Separate abstracts are included for each of the 22 papers presented concerning the mechanical effects of core accidents, analysis of hypothetical accidents, sodium-air reactions, and accident activity release. (DCC)

For abstracts of individual papers see: 9353 and 9462–9482.

9462 (CONF-721006-P3, pp 991-1034) MECHANICAL EFFECTS OF CORE ACCIDENTS. Rees, N. J. M. (Atomic Weapons Research Establishment, Foulness, Eng.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The present state of our understanding of the effects of uncontrolled energy releases in fast reactors is reviewed. Two levels of energy release are likely to have serious consequences for reactor safety: firstly, fuel-coolant interactions involving a large proportion of the fuel in a single sub-assembly; secondly, a whole core power excursion in which some of the fuel is vaporized. The assessment of the mechanical effects of any accident of this kind must start with an accurate knowledge of the amount of energy involved and the rate at which it is released. In the case of the subassembly thermal interaction this knowledge is not available, and a technical judgment of the type of pressurization likely is being used as the basis of simulation experiments in models of fast reactor cores. In the case of the whole core accident, recent evaluations of the mechanical energy available using the Bethe–Tait model have indicated fuel vapor pressures of a few kilo-bars, even for large energy releases. This has meant that high explosives are no longer a good simulant of this type of accidental energy release. Development of "low" explosives, some containing pyrotechnics and some without, has started at a number of

centres to more accurately simulate the energy release process. Considerable effort at various centres has been put into computer codes which describe the pressure wave propagation and damage process in reactor structures. In order to use these codes as effectively as possible, they have to be validated very carefully using data from various model experiments on current reactor designs. 61 references. (auth)

9463 (CONF-721006-P3, pp 1035-1071) STUDY OF NUCLEAR ACCIDENTS BY CHEMICAL SIMULATION EXPERIMENTS. Egleme, M. (Belgonucleaire, Brussels); Namias, M.; Holtbecker, A. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

On the basis of Bethe–Tait calculations the main characteristics of the design basis accident of the SNR reactor have been established. The use of a chemical pyrotechnic mixture ($KClO_4$, $Ba(NO_3)_2$ and Mg) seemed the best way to simulate the accident. Tests have been performed to determine the main powder characteristics: the deflagration velocity and the energy release. The experimental results have been analyzed with a computer code, named DEBUL, which describes the coupled hydro- and thermodynamic behaviour of the gas-water system. Another series of tests was carried out in Ispra. Explosive charges were fired in rigid or yielding vessels at the $1/12$ scale. Twenty-five experiments have been done in a thick walled vessel with the principal aim of calibrating computer codes (DRAP, SURBOUM) and of demonstrating the performance of the vessel engineered safeguards in case of a nuclear accident. Eight experiments were performed in thin walled vessels. All these experiments are being analyzed with the SURBOUM II computer code. This code was developed to study the two dimensional pressure time history in a fast reactor vessel after a rapid energy input. The DEBUL code, previously mentioned, can be used as a subroutine of the SURBOUM II code. Comparison of experimental and theoretical results shows that the SURBOUM II code coupled with the DEBUL code can describe the phenomena. 5 references. (auth)

9464 (CONF-721006-P3, pp 1072-1083) COMPARISON OF THE PRESSURE EFFECTS OF ENERGY RELEASE FROM NUCLEAR EXCURSIONS AND CHEMICAL SIMULATIONS. Cowler, M. S.; Hoskin, N. E. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

For several years the philosophy of equating damage from nuclear and chemical explosions was widely accepted. To illustrate the non-validity of this hypothesis in simple systems, one-dimensional spherical calculations have been made for a simple charge geometry and with a yielding casing typical of a fast reactor cross section. Input for UO_2 explosions was derived from the output of Bethe–Tait calculations and a range of energy releases has been considered. The mass of HE was chosen to match the work done by the energy source on the surrounding medium. The calculations were taken as far as the first maximum in extension of the primary tank, and this used as a criterion of damage potential. It is shown that the tank extension for a UO_2 excursion is about twice that produced by the corresponding energy release from high explosive. Gas spaces and inert layers surrounding the core do not reduce this factor significantly. 13 references. (auth)

9465 (CONF-721006-P3, pp 1084-1105) CALCULATION OF THE DYNAMIC RESPONSE OF REACTOR CONTAINMENT SYSTEMS. Hoskin, N. E. (United Kingdom Atomic Energy Authority, Aldermaston, Eng.); Mawbey, M. W. S.; Rees, N. J. M. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Two methods of assessing the mechanical effects of rapid energy release within a fast reactor structure are discussed. The first part demonstrates the use of ASTARTE, a time dependent two-dimensional Lagrangian hydrodynamics code developed to determine the flow of coolant and the loadings, impulses and strains exerted upon the reactor structure from a local energy release. This can either be from the detonation of chemical explosive or a high pressure bubble or, if estimated equations of state for the materials in a vaporized core are included, the consequences of a nuclear excursion can be predicted. To demonstrate the validity of the code results are presented for predicted impulses for model tests for a single tank pool-type reactor geometry showing accurate predictions (i.e., within 20%) in time, shape and magnitude when compared with experiment. The extension to hypothetical nuclear excursions is indicated. The second part describes an investigation to provide design information on the structural integrity of the Prototype Fast Reactor (PFR) system by using $1/16$th scale models and a charge of chemical explosive to roughly simulate a hypothetical energy release in the core. From the measured pressure loadings the deflection of the model roof and its reaction forces have been calculated using an analogue computer and compared with dynamic measurements, confirming the theoretical representations. The response of the full scale PFR structure to similar pressure loadings has also been calculated after allowing for differences in detail between model and PFR and for non-scalable effects such as gravity. 13 references. (auth)

9466 (CONF-721006-P3, pp 1131-1150) FAST REACTOR CORE MELTDOWN ACCIDENT AND THE REACTOR VESSEL RESPONSE. Kawaguchi, O. (Power Reactor and Nuclear Fuel Development Corp., Tokyo); Kishida, K.; Ueno, K.; Sawada, T.; Kondo, S.; An, S.; Uchida, T. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Core meltdown accident in fast reactors and its containability in the reactor vessel have been investigated by the analysis with some experimental evaluation. The analysis consists of three steps: accident progression prior to core disassembly; core disassembly and nuclear excursion; and mechanical response of a typical reactor vessel. The development of an accidental condition caused by certain postulated incidents is analyzed in the step I of the analysis. The parameters of this accident progression are fed to the step II where the nuclear excursion is to be computed. In the step III, the mechanical response to nuclear excursion of a typical reactor vessel design is investigated by various methods. 13 references. (auth)

9467 (CONF-721006-P3, pp 1151-1166) SOME STUDIES OF DYNAMIC EFFECTS AND THERMAL INTERACTIONS IN FAST REACTOR WHOLE-CORE MELTDOWN ACCIDENTS. Booth, D. L. (British Nuclear Design and Construction Ltd., Whetstone, Eng.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The dynamic forces which act upon the containment system because of the expansion of fuel vapour and fission products can be calculated for whole-core meltdown accident situations with stated input conditions and assumed simple geometries. It is more difficult to estimate the dynamic forces which might act upon the containment in accidents which include the transient exchange of heat between, for example, liquid UO_2 at 3500 K and liquid sodium at 900 K. These thermal interactions modify the behaviour of the basic oscillatory system of fuel vapour bubble, bulk sodium and argon blanket gas. The WITCHES BREW computer programme has been developed for the study of whole core thermal interactions and the resultant containment loadings. (auth)

9468 (CONF-721006-P3, pp 1167-1194) CONTAINMENT OF FAST BREEDER REACTOR: RECENT DEVELOPMENTS IN ANALYTICAL AND EXPERIMENTAL METHODS. Denise, R. P. (Atomic Energy Commission, Washington, DC); Speis, T. P.; Fistedis, S. H.; Chang, Y.; Stepnewski, D. D.; Fox, G. L.; Florence, A. L.; Abrahamson, G. R. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The primary boundary of a liquid metal fast breeder reactor (LMFBR) is designed in such a way as to assure the capability of removing the decay heat from the damaged core in the event of a hypothetical core disruptive accident (HCDA). In an LMFBR, the reactor vessel, the vessel head, and the primary loop (i.e., piping, heat exchanger, pumps, etc.) constitute the primary containment whose integrity should be assured if the decay heat requirements are to be met following the HCDA. The accidents used to test the integrity of this containment barrier are basically postulated, since credible mechanistic causes for such accidents have not been identified. The USAEC's analytical and experimental programs pertaining to the evaluation and/or understanding of the response of the primary containment of an LMFBR following a core disruptive accident are reviewed. 29 references. (auth)

9469 (CONF-721006-P3, pp 1195-1217) COMPARISON OF THEORETICAL AND EXPERIMENTAL RESULTS CONCERNING A PROMPT CRITICAL EXCURSION OF A FAST BREEDER REACTOR. Benuzzi, A.; Fasoli-Stella, P.; Holtbecker, H. (EURATOM, Ispra, Italy). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The REXCO-H code developed by ANL has been applied and modified in order to compare its results with the experimental

data obtained in the frame of the Fast Breeder Safety Programme (JRC-EURATOM-ISPRA). In addition the comparison has been extended to the results calculated by the SURBOUM code developed by BN. The REXCO-H code uses the equations of compressible hydrodynamics in Lagrangian coordinates; the SURBOUM code is written in Eulerian coordinates and deals with viscous incompressible fluid flow. The limits of applicability of these two codes are discussed. 8 references. (auth)

9470 (CONF-721006-P3, pp 1221-1234) PROGRESS IN ANALYSIS OF SEVERE ACCIDENTS. Fischer, G. J.; Bohl, W. R.; Dunn, F. E.; Heames, T. J.; Jackson, J. F.; Nicholson, R. B.; Smith, L. L.; Stevenson, M. G.; Travis, J. R.; Watanabe, A. (Argonne National Lab., IL). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The capabilities for safety analysis recently developed at Argonne National Laboratory are described for coastdown and ramp accidents without scram. Some of the most pertinent test experiments are identified and discussed. 4 references. (auth)

9471 (CONF-721006-P3, pp 1235-1266) ANALYSIS OF HYPOTHETICAL ACCIDENTS FOR SNR 300. Heusener, G. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.); Kessler, G.; Bohl, W. R. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Superprompt critical energy releases in SNR-300 are considered as extremely hypothetical events, since a very improbable chain of accidents and simultaneous failure of two shutdown systems must be assumed to occur. Nevertheless such hypothetical accidents are analyzed for SNR-300 in order to have a design basis for the primary containment. Having this design basis, engineered safeguards and other design measures can be provided for limiting the consequences of such an accident. The definition of this primary containment design basis requires detailed calculations of the mechanical energy release for two main hypothetical accident chains: pump coast-down with simultaneous failure of the two independent scram systems; and reactivity accidents with simultaneous failure of the two independent scram systems. The codes SAS2A, VENUS, the sodium-fuel interaction model of Cho and Wright, and the codes REXCO-H, ARES, HEINKO and DRAP were applied for the analysis of both accident chains. 32 references. (auth)

9472 (CONF-721006-P3, pp 1267-1286) ANALYSIS OF SEVERE ACCIDENTS IN FAST REACTORS OF GREAT POWER. Causes and Consequences. Puig, I.; Antonakas, D. (CEN, Cadarache, France). 1973. (In French).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Though all the events leading to a large reactivity increase cannot be defined, some of the primary malfunctions can be guessed. The explosion of a peripheral subassembly, due to a vapor explosion after blocking and fuel melting, could crush the core. The reactivity change has been evaluated assuming various core configurations. The unprotected flow coastdown is dealt with: it can result in sodium boiling, and fuel melting, and then give rise to a reactivity increase. The mechanical energy release after a whole core accident is only large if it results in a fuel sodium interaction. This energy is evaluated with various assumptions. The effect of this energy on the containment, due to sodium hammer, and vessel deformation are discussed. 4 references. (auth)

9473 (CONF-721006-P3, pp 1287-1304) CONTRIBUTION OF BETHE-TAIT ANALYSIS TO THE ASSESSMENT OF FAST REACTOR SAFETY. Edwards, A. G.; Mather, D. J. (United Kingdom Atomic Energy Authority, Risley, Eng.). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The Bethe-Tait procedure for assessing excursion yield in fast reactor accident studies is well known as an approximate method suitable for survey purposes. It has been used extensively, in both two-dimensional and one-dimensional geometry, for medium and large size LMFBRs of interest in the UK programme. Because a wide variety of primary input data is of interest, emphasis has been laid on deriving intermediate parameters to specify a reactor's excursion characteristics, and on representing conveniently the large number of calculated excursion yields available. It is found that uncertainties in the equation of state of UO_2 are unlikely to be very important, and that the effect of uniformly distributed fission products is beneficial. However the basic method involves approximations and the adequacy of these has been studied with particular reference to the effects of fuel density changes in giving pressure relief and in invalidating the use of perturbation theory. Fuel granulation also affects excursion yield in a rather complex way, but in certain cases appears to offer a safety bonus. (auth)

9474 (CONF-721006-P3, pp 1305-1311) SODIUM WATER REACTION IN THE REHEATER OF THE 50 MW TEST FACILITY AT HENGELO. de Clercq, W. J. C. (Neratoom, The Hague). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The sodium-water reaction which took place in the 50 MW sodium test facility at Hengelo is analyzed. Design parameters of the test facility are presented. Actions following the incident are described. An examination for damage to facility components is summarized. (DCC)

9475 (CONF-721006-P3, pp 1312-1330) SEFOR EXPERIMENTAL RESULTS AND APPLICATION TO LMFBR's. Caldarola, L. (EURATOM, Karlsruhe, Ger.); Freeman, D. D.; Greebler, P.; Kussmaul, G.; Mitzel, F.; Noble, L. D.; Pflasterer, G. R.; Oosterkamp, W. J.; Wintzer, D. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The SEFOR experimental program, which began with core loading in April, 1969, was successfully completed in January, 1972. The program consisted of a series of static, oscillation, and transient tests (both sub-prompt and super-prompt critical). The sodium cooled, PuO_2-UO_2 fueled SEFOR core has a composition, neutron spectrum, and fuel temperature profiles that are characteristic of large LMFBRs. The central objective of the experimental program was to verify that the LMFBR has a prompt negative Doppler coefficient of sufficient magnitude to make it an extremely stable and inherently safe reactor system; and to obtain an accurate measurement of the coefficient. The super-prompt critical transient tests, in particular, involving reactivity insertions up to 1.3$ in 0.1 second, provided a most convincing demonstration of the effectiveness of the Doppler coefficient in limiting the energy release in a fast reactor power excursion. 22 references. (auth)

9476 (CONF-721006-P3, pp 1331-1354) REACTOR POWER EXCURSION STUDIES. Stratton, W. R.; Engle, L. B.; Peterson, D. M. (Los Alamos Scientific Lab., NM). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

A coupled neutronics-hydrodynamics code in spherical coordinates has been developed with a neutron transport code and with an equation of state which allows for both condensed and vapor phases. This code has been tested by calculation of the GOVIDA, KIWI-TNT, and SNAPTRAN series of excursion experiments. Without special normalization the fission energy release and conversion to explosive (kinetic) energy are reproduced within a factor of two. Making use of an equation of state for UO_2/PuO_2 and sodium the code has been applied to the calculation of hypothetical accidents of fast breeder reactors. Parameters which have been varied include the core volume, Doppler coefficient, initial power, reactivity insertion rate, and heat transfer rate to sodium. 21 references. (auth)

9477 (CONF-721006-P3, pp 1357-1362) SODIUM COMBUSTION AND ITS EXTINGUISHMENT: TECHNIQUES AND TECHNOLOGY. Inyutin, E. I. (IAEA, Vienna). 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The detection of sodium leaks and fires, extinguishment of sodium fires, and sodium combustion products are reviewed. Conditions for the detection of sodium leaks in nuclear reactors and test facilities, reliability of present detection methods, philosophy of extinguishment techniques, methods used in present facilities, protective clothing, actual performance of extinguishment during large fires (more than 100 litres of sodium), proposed techniques for large LMFBRs, safety hazards, potential damage and abatement of smoke and solid residue, and cleaning problems are discussed. (auth)

9478 (CONF-721006-P3, pp 1363-1385) SODIUM FIRES AND FAST REACTORS. Falgayrettes, M. (CEN, Cadarache, France). 1973. (In French).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Sodium fires as a consequence of leakages are an important potential risk in fast reactors. It is difficult to assign a prob-

ability to this accident; on the basis of experiments carried out by CEA (ETNA), however, one can try to visualize the processes leading to leakages of sufficient importance to be a risk for the reactor. The safety of operation is increased by taking measures quickly, therefore it is necessary to have early detection devices and specific means of rapid counter-action. For this reason leak detection methods as well as specific extinction methods have been studied. The commercial products suitable for extinguishing metal fires have been tested separately. Experiments on a very large scale—MEPHISTO (200 litres of sodium)—have been carried out under representative conditions of a large leak in a tube system. They have shown the difficulty to achieve fire extinction by means of chemical extinction products; other methods have been tried in the same experimental configuration. 13 references. (auth)

9479 (CONF-721006-P3, pp 1386-1405) FAST REACTOR CONTAINMENT BEHAVIOR TOWARD SODIUM AEROSOLS. Candes, P.; Colome, J. (CEA, Paris). 1973. (In French).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

First a brief survey is given of the principal features of the containment chosen for the reactor Phénix in connection with the choice of site, normal operating and accident conditions. This survey is followed by a discussion of the principles chosen for minimizing the radiation doses which might result for the environment. On the basis of these choices an experimental study programme has been started. A description of the programme and its present stage follows: study of sodium spray or pool fire in a 25 m^3 container and aerosol transport phenomena; and starting a new part of the programme in a 400 m^3 container equipped with a ventilation and filter system adaptable to various conditions. The entire programme and the development of additional investigations are discussed. 8 references. (auth)

9480 (CONF-721006-P3, pp 1406-1422) BEHAVIOR OF SODIUM OXIDE AND FISSION PRODUCTS UNDER SODIUM POOL FIRE. Kawahara, S. (Hitachi Ltd., Ibaraki, Japan); Yusa, H.; Kamiya, K.; Kawaguchi, O.; Fukushima, Y. 1973.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

Release fractions of sodium oxide aerosol, and of the typical fission products iodine and cesium in the event of sodium pool fire were measured. The results are presented of a small-scale experiment conducted to investigate the effects of burning conditions such as sodium initial temperature, gas flow rate, oxygen concentration and humidity on the release fractions of the stated three substances. The experiment revealed that release fraction is largest for cesium and smaller for sodium and iodine in the order mentioned, and that the release fractions of the substances increase with the rise of temperature and flow rate, and with the decrease of oxygen concentration and humidity. Particularly, our findings disproved the common belief that in order to inhibit sodium combustion, oxygen content and humidity should be reduced. Since the experiment was conducted on an extremely small scale it is doubtful whether the results are general enough to be used as basic data for hazard analysis of sodium-cooled fast breeder reactors. (auth)

9481 (CONF-721006-P3, pp 1423-1441) AEROSOL BEHAVIOR AND RADIOLOGICAL EFFECTS OF ACTIVITY RELEASE IN AN ACCIDENT OF SNR. Keller, K. (Gesellschaft fuer Kernforschung, Karlsruhe, Ger.); Schikarski, W.; Wild, H.; Muehlhoff, W.; Oeynhausen, H.; Schenkel, J.; Scholle, U.; van de Vate, J. F. 1973. (In German).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The behavior of nuclear aerosols in a fast reactor accident is of vital importance for an assessment of the environmental effects due to a release of radioactive materials. The possible release of fuel aerosols and some fission-product aerosols in case of a core destruction is of particular interest. The most important severe accidents and their mechanism concerning activity release are discussed, together with an explanation of the functions of the containment system. The reventing system is of particular importance, since it can enclose the activity during the first 40 days after a severe accident, before abducting the activity through the exventing system. The basic aerosol behavior in an SNR containment has been studied by GfK and RCN in experimental programs. The experiments were supported by the development of a computer code and an analytic model theory. In this way the essential features of aerosol behavior in SNR containments and of activity release have been clarified. On the basis of these studies the environmental effects due to an accident have been calculated. The assumptions made in connection with the containment concept by Interatom are discussed and commented on. 10 references. (auth)

9482 (CONF-721006-P3, pp 1442-1455) INVESTIGATION OF SODIUM FIRES. Huber, F.; Menzenhauer, P.; Peppler, W.; Till, W. (Kernforschungszentrum, Karlsruhe, Ger.). 1973. (In German).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The test set-up and the building are described. The sodium area conflagrations were executed in a pan with 1 m^2 base area. To confine the fire a special cover of the pan was tested. This set-up was also used during spray fires and fires at insulated pipe sections. For each test 60 l of sodium at a maximum temperature of 600°C were available. Different fire-extinguishing methods were tested. While using the pan together with the special cover no fire-extinguishing activities had to be taken. This set-up therefore represents an optimum protection of the personnel, the equipment and the surroundings. Fires at insulated pipe sections showed a very diversified behavior depending on the insulation material used. Already small amounts of moisture in the insulation material resulted in violent reactions. (auth)

9483 (FIND-50206) FIND: SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Patton, B. L. (ed.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Nov 1973. 45p. Dep. NTIS $4.00.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (JWR)

9484 (GEAP-10207-29) REACTOR PRIMARY COOLANT SYSTEM PIPE RUPTURE STUDY. Progress Report No. 29, January–June 1973. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). Aug 1973. Contract AT(04-3)-189. 83p. Dep. NTIS $5.45.

The pipe rupture study is designed to extend the understanding of failure-causing mechanisms and to provide improved capability for evaluating reactor piping systems to minimize the probability of failures. Following a detailed review to determine the effort most needed to improve nuclear system piping (Phase I), analytical and experimental efforts (Phase II) were started in 1965. The recent accomplishments of a broad program in (a) fatigue studies through both bench-scale and large-component tests, (b) at-reactor tests of the effect of primary coolant environment on the fatigue behavior of piping steels, and (c) failure probability study of actual reactor piping systems, are presented. (auth)

9485 (GEAP-13923-4) SAFETY ENGINEERING FOURTH QUARTERLY REPORT, MAY–JULY 1973. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). Jul 1973. Contract AT(04-3)-893. 36p. AT.

The Demonstration Plant will demonstrate the safe, economical generation of electric power from a liquid-metal cooled fast breeder reactor. Many aspects of the safety of such a plant have been under study for several years. The purpose of the Safety Engineering Task (TA 893-2) is: (1) to bring into sharp focus both the requirements for specific technical information related to safety, and the results of previous studies, wherever performed; (2) to recommend to AEC-RRD a course of action which will provide the information still required. The existing LMFBR national safety development program includes both analytical and experimental programs. The Safety Engineering Task utilizes the results of these programs to evaluate their applicability to LMFBR conditions. This goal is obtained by direct use of nationally developed accident-analysis codes and by active participation in the evaluation of safety-related experimental data through both: (1) round-robin analyses of current experimental tests involving ANL and HEDL; (2) independent review and analysis of existing experimental tests. The results of these activities are in the form of correlations of existing data and recommendations on future directions for safety development experimental programs. (54 references) (auth)

9486 (HEDL-SA-510) EXPERIMENTAL METHODS FOR OBSERVING THE MELTING BEHAVIOR OF IRRADIATED FUELS. Slagle, O. D.; Hinman, C. A.; Weber, E. T. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1973. 13p. (CONF-731041-4). Dep. NTIS $3.00.

From American Ceramics Society nuclear division meeting; San Francisco, California, USA (29 Oct 1973).

An experimental program is underway at HEDL to study the behavior of irradiated mixed oxide fuel material heated rapidly through the melting temperature. Of particular interest is the release of fission gas and the fuel motion effected by this release. This type of information is necessary in describing fuel behavior associated with hypothetical accident conditions considered in fast reactor safety analyses. The experimental techniques being used

to observe the behavior of irradiated fuel material heated rapidly to melting are described. (auth)

9487 (HEDL-TME-73-4(Vol.2)) HEDL QUARTERLY TECHNICAL REPORT, APRIL–JUNE 1973. Volume 2. Reactor and Safety Engineering. Grace, J. N. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1973. Contract AT (45-1)-2170. 40p. AT.

Physics and nuclear engineering work during the quarter included collection of nuclear data, critical experiment analyses, FTR nuclear design, FTR shielding studies, and development of an irradiation test management program. Safety analysis and engineering included evaluations of hypothetical core description accidents in the FTR. (JWR)

9488 (IRS-F-16) REPORTS ON RESEARCH PROGRAMS IN THE FIELD OF REACTOR SAFETY PROMOTED BY THE FEDERAL MINISTRY FOR RESEARCH AND TECHNOLOGY. Quarterly Report, April 1–June 30, 1973. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs Vereine e.V., Cologne (F.R. Germany)). Aug 1973. 233p. (In German). Dep. NTIS (U.S. Sales Only) $13.75.

9489 (KFK-1834) ANALYSIS OF HYPOTHETICAL ACCIDENTS FOR SNR-300. Heusener, G.; Kessler, G.; Lauber, H. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Sep 1973. 142p. Dep. NTIS (U. S. Sales Only) $9.25.

Possible effects of extremely hypothetical accident chains are investigated and discussed for the definition of a design basis of the containment system of the SNR-300. Two accident chains are analyzed in detail: pump coast down with simultaneous failure of the two independent scram systems; and reactivity accidents with simultaneous failure of the two independent scram systems. The accident course is followed to the point where pressure loads are imposed on the reactor tank systems after core disassembly and very rapid energy transfer from hot molten and vaporized fuel to sodium. Maximum strains and stresses in the tank system are calculated and discussed. (71 references) (auth)

9490 (NEDO-10320(Suppl.2)) CALCULATION OF THE OVERALL FLOW LOSS COEFFICIENT FOR THE VENT SYSTEM OF A TORUS/LIGHTBULB CONTAINMENT. James, A. J.; Libkind, M. A. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). Jan 1973. 23p.

The analytical modeling used by General Electric Company to simulate the short-term transient in a pressure suppression type of containment following a loss-of-coolant accident is described in the GE Topical Report NEDO-10320. One factor in evaluating the transient pressure differential between the drywell and wetwell is the overall flow loss coefficient of the vent system that connects the two chambers. The methods used to calculate this loss coefficient for a torus/lightbulb type of reactor containment are described. Specifically, the analysis for the Cooper Nuclear Station is presented. There are minor variations in vent geometry from plant to plant, but the methods used to evaluate the vent flow loss coefficients for all torus/lightbulb (Mark I) containments are essentially the same as those presented. Included is an identification of all losses, the loss coefficient used for each, the reference for that coefficient, and the method of combining the various individual losses into an overall loss coefficient for use in containment analysis. The loss coefficient used for containment pressure transient analysis is shown to be conservative relative to the rigorously calculated value. 3 references. (auth)

9491 (NEDO-10585) BEHAVIOR OF IODINE IN REACTOR WATER DURING PLANT SHUTDOWN AND STARTUP. Brutschy, F. J.; Hills, C. R.; Horton, N. R.; Levine, A. J. (General Electric Co., San Jose, Calif. (USA). Atomic Power Equipment Dept.). Aug 1972. 65p. (72-NED-56). Dep. NTIS $5.25.

The behavior of iodine-131 in the reactor water during power and pressure changes has been reviewed and evaluated due to concern that the radio-iodine level may attain values which may result in dose consequences in excess of guideline limits as calculated for postulated accidents. Data show that a temporary increase in the iodine concentration of the reactor coolant occurs at some time after a substantial change of power level or pressure in the reactor plant. A number of utilities obtained iodine measurements during reactor startup and shutdown conditions. The data and the effects of the hypothetical instrument line break accident on potential radiological exposures are evaluated. It is shown that there is a correlation between the magnitude of the increase in iodine concentration (spike) and the fission gas to iodine ratio. A spike resulting in the predicted maximum iodine-131 concentration is shown to result in acceptable off-site dose rates from a postulated instrument line break accident. The effect of an iodine-131 spike occurring during a rapid restart following a scram is also evaluated. (auth)

9492 (NJD-23(Suppl.)) IMPACT OF INCREASED NERVA REACTOR-ENGINE TESTING ON RADIOLOGICAL SAFETY. (Aerojet-General Corp., Sacramento, Calif. (USA); Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Feb 1970. 5p. Dep. NTIS $3.00.

Declassified 29 Aug 1973.

Data on the NERVA reactor radiological safety aspects are presented concerning uranium loss as a function of core reactivity loss, corrosion source terms, and advantages and disadvantages of ZrC–UC composite fuel. (auth)

9493 (ORO-3822-4) EFFECT OF SOIL-STRUCTURE INTERACTION ON THE RESPONSE OF REACTOR STRUCTURES TO SEISMIC GROUND MOTION. Final Report. Chiapetta, R. (IIT Research Inst., Chicago, Ill. (USA)). Apr 1970. Contract AT(40-1)-3822. 95p. (IITRI-J-6157). Dep. NTIS $6.75.

The effect of soil-structure interaction on the response of nuclear reactor structures to seismic ground motions is investigated. A two-dimensional dynamic analysis of the reactors and soil foundation is conducted utilizing IITRI's large-scale finite element computer code, SLAM. The reactors are modeled as combinations of rigid bodies, linear springs and lumped masses. The soil is represented by elastic, finite elements. The loading environment is based on idealized earthquake motion records. Calculations are made for two reactors on the surface and one partially embedded in a uniform alluvium foundation. Translational and rocking motions and associated shock spectra of the reactor bases are computed. The spectra for the translational motion is compared to the spectra for the corresponding free field motions. It is shown that the neglect of soil-structure interaction in the design of reactor structures, for translational motion of the base, results in highly conservative design. Although the results of this study show some indication of a significant effect of base rocking on the response of reactor structures, the evidence is inconclusive. (auth)

9494 (RT/ING-(73)7) STUDIES AND EXPERIMENTS ON CORE SAFETY PERFORMED AT USTS (CNEN). Pinchera, G. C.; Martini, M.; Tomassetti, G. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 30 Jun 1973. 32p. (CONF-721006-9). Dep. NTIS (U.S. Sales Only) $3.50.

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The scope, interconnection and results of various research lines on core safety are described with particular reference to local accidents: sodium boiling; sodium-fuel interaction; fuel-element testing with electrically-heated partial mock-ups; ENAFUSPEC thermalhydraulic code; and development of electrically-heated, instrumented, simulated fuel bundles. 31 references. (auth)

9495 (TID-3525-R5-S8) REACTOR SAFETY. A Literature Search. Raleigh, H. D. (comp.). (USAEC Technical Information Center, Oak Ridge, Tenn.). Dec 1973. 67p. Dep. NTIS $5.45.

Included are 267 citations to references issued during the period January 1972 through June 1973 on safety aspects of nuclear reactor design, siting, materials, engineered safeguards, and operating procedures. Reports cited concern hazards analyses of entire facilities to satisfy construction and operation permit requirements, evaluation of the reliability of reactor systems and components, and analyses of the consequences of potential accident conditions. Subject, author, corporate author, and report number-availability indexes are included. (auth)

9496 (WASH-1256-R1) SUMMARY REPORT ON THE ASSESSMENT OF ENVIRONMENTAL RADIOACTIVITY IN THE VICINITY OF THE SHIPPINGPORT POWER STATION. (USAEC Division of Operational Safety, Washington, D.C.). Aug 1973. 136p. Dep. NTIS $9.00.

Surveys show that Shippingport Reactor has not contaminated environmental media as only background levels of radioactivity were found in the vicinity. Analyses of the primary coolant and waste streams indicate extremely low radioactivity releases. Gaseous discharges totaled less than 1 m Ci/year since 1967. (FS)

9497 (WCAP-5108) FLECHT-SYSTEMS EFFECTS TESTS PHASE A RESULTS. Blaisdell, J. A.; Cadek, F. F.; Hochreiter, L. E.; Suda, A. P.; Waring, J. P. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA). Atomic Power Div.). 1973. Contract AT(11-1)-2279. 5p. (CONF-731101-22). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The PWR FLECHT test facility has been modified such that it more nearly simulates the reflood phase of a LOCA. A downcomer and an exhaust loop were added to the existing FLECHT 10 × 10 test section. The exhaust loop included a liquid separator

in the position normally occupied by the steam generator. Downstream of the separator the piping was heated well above saturation temperature to insure single phase steam flow through the orifice which provided additional flow resistance and a means for measuring the vapor flow rate. The steam discharged to a large tank which was maintained at constant pressure by an exhaust control valve. Test results are included. (auth)

9498 (WCAP-7983) SMALL LOSS OF COOLANT ACCIDENT ANALYSIS FOR PWR SYSTEMS (SLAP DIGITAL COMPUTER CODE). Augustine, G. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). Dec 1972. 56p.

The digital computer code SLAP (Small Loss-of-Coolant Accident Program), a time-dependent mathematical model describing the behavior of a PWR nuclear power plant undergoing a small loss of primary coolant accident, up to approximately 0.2 ft^2, is described. The program applies to all closed-cycle, light-water reactors. The differential equations for conservation of system mass, energy, and momentum are presented. These equations are expressed in finite difference form and integrated numerically in time. Results are printed out in an easily understood form. Computer plots are also available. The mathematical model and the numerical techniques utilized in the digital analysis are verified by comparing the theoretical results against available data from the Westinghouse Waltz Mill test facility. The tests and the analysis are found to be in good agreement. The program is presently written for the CDC 7600. A typical case requires about 4 minutes of computer time. (auth)

9499 ENVIRONMENTAL ASPECTS OF NUCLEAR POWER GENERATION. Kobayashi, S. (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Genshiryoku Gakkaishi; 15: No. 2, 69-85(Feb 1973). (In Japanese).

Environmental problems associated with the operation of an atomic power plant are described. These problems include: the kind of radioactive nuclides and radiation dose; ecological movements of radioactive nuclides and the kind and the degree of radiation exposure (external exposure and internal exposure); biological effects of low-dose (minute amount) radiation; standards for radiation protection and estimation of the degree of radiation hazard; and environmental problems other than radiation. The path of radioactive nuclides in the environment until they reach the human body through food chain and importance of their concentration in living things during that time are stated. Bodily effects, genetic effects, and the degree of genetic danger from internal exposure and compound pollution are discussed. Delayed bodily effects, such as: malignant neoplasms including leukemia, tumors of various organs in the body (thyroid gland tumor, etc.), opacitas cornea (cataract), genetic abnormality of fetus, and shortening of life are mentioned. Genetic effects were divided into chromosome abnormality and genic mutation from a viewpoint of genetic mechanism. Dominant mutation, recessive mutation, sex-linked mutation, and multigenetic mutation manifestations of mutation are considered. Dose standards, the maximum permissible dose, and limitation of dose recommended by ICRP, and legal regulation in Japan are mentioned. Standards on dose restrictions for reactor installations in Japan, U. S. A., Canada, West Germany, U. S. S. R. and England are compared with each other. The environmental effects of thermal effluents from nuclear power plants, specifically the effects of seawater heating on marine organisms are described. (JA)

9500 REACTOR ACCIDENT CASES IN THE NUCLEAR INSTALLATION. Nakajima, T. (Japan Atomic Energy Research Inst., Tokai). Kagaku (Tokyo); 43: No. 2, 110-119(Feb 1973). (In Japanese).

Reactor accidents and safety measures at nuclear installations are discussed using information from reports on operational accidents and radiation exposure experience within the USAEC, Japan, and the UK. Accident records with detailed data on reactor sites, radioactive substances, possible cause, physical damages, economical loss, exposure dose, reactor components and operation at the time of accidents are discussed. Specific examples include the stationary low power reactor-1 accident in Idaho in 1961, Windscale reactor accident in Sellafield, England in 1957, and JRR-3 reactor fuel accidents in Japan in 1968 and again in 1969. Since the cause of accidents is involved with human factors, the rights of workers should be protected and their training should be enforced with recognition of social obligation and public safety. The three principles, i.e., public announcement of the accident, extensive investigation on the cause of the accident, and countermeasures, should be preserved and enforced to improve reactor safety standards. (JA)

9501 EVALUATION OF ACCIDENTS IN NUCLEAR POWER STATIONS. Fujimoto, Y. (Waseda Univ., Tokyo); Yoda, H. Kagaku (Tokyo); 43: No. 3, 163-170(Mar 1973). (In Japanese).

In considering the safety of the inhabitants around the station, possible accidents must be analyzed based upon "the maximum hypothetical accident" which can be determined theoretically. One of the major problems involved with assessing possible accidents is that the Japan Atomic Energy Commission is reviewing the safety problems behind closed doors. According to calculations by the USAEC, the amount of ^{131}I released into the air is about 10^5 Ci from a boiler with 3,000,000 kW heat energy. In Japan, however, the value is lower in reports investigating safety problems of power station boilers, and there is a considerable variation between power stations. In the case of an accident in a nuclear power station boiler, the following types of radiation exposure would occur: direct γ-ray external radiation from indoor radioactive substances; γ-ray external radiation from radioactive mist; internal radiation from the inhalation of radioactive mist; internal radiation from eating crops directly contaminated by precipitated radioactive mist, and continued radioactivity of crops grown in ground contaminated with precipitated radioactive mist. In their assessment of the safety factors of the power plants, however, the Japan Atomic Energy Committee did not consider 4 and 5. This deficiency is a serious problem. Although radioactive mist is dispersed over hundreds of kilometers by wind currents, with high doses, in Japan all atomic power stations are located within 1 km of residential areas. Furthermore, although 25 rem causes acute disturbance, it is not a satisfactory standard of maximum permissible dose, because delayed and genetic radiation effects can possibly be caused by less than 25 rem. (JA)

9502 SEISMIC ANALYSIS OF THE PRIMARY CIRCUIT OF THE PEC REACTOR. Chelli, L. (CNEN, Bologna); Papa, G.; Misley, P.; Pietrantoni, P. pp 181-188 of Metodi di Calcolo e di Provo di Structture Soggette a Vibrazioni. II. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In Italian).

From conference on computation and test methods for vibrating structures; Pisa, Italy (1972).

Seismic analysis of the primary piping system for PEC reactor is presented. A mathematical model using the lumped constants approximation is derived from airplane structure calculation techniques. The free vibration modes of the primary circuit, loaded with a seismic excitation having a selected design spectrum, are derived. Numerical calculation of the free vibration eigenvalues is performed by a computer program using Choleski method. The static analysis is made by the SPANDE and STRUDL computer codes. (INIS)

9503 METHODS FOR CALCULATING VAPOR AND FUEL TRANSPORT TO THE SECONDARY CONTAINMENT IN AN LMFBR ACCIDENT. Kennedy, M. F.; Reynolds, A. B. (Univ. of Virginia, Charlottesville). Nucl. Technol.; 20: No. 3, 149-160(Dec 1973).

Calculational models were developed for estimating the transport of sodium vapor and the relatively large ($\geq$10-μm) fuel particles resulting from a fuel-coolant interaction to the secondary containment in an LMFBR core disruptive accident. Following the formation of a large sodium vapor bubble resulting from a fuel-coolant interaction, a potential sequence of events was analyzed. This analysis covers bubble condensation, bubble rise time, aerosol fallout during the bubble rise, gas flow rate through the cover, cover-gas escape during the bubble rise, bubble and cover-gas mixing, and aerosol escape to the secondary containment. Two parametric calculations were made for specified accident conditions for a 1000-MW(e) LMFBR conceptual design. The bubble did not condense in this analysis. Results of the analysis indicated that 2 and 10% of the fuel that took part in the fuel-coolant interaction eventually reached the secondary containment for the two assumed flow areas through the cover, i.e., 0.1 and 1.0 ft^2, respectively. (auth)

9504 NUCLEAR POWER PLANT HEAT REJECTION IN AN ARID CLIMATE. Scofield, F. C. (Omaha Public Power District, NE); Fazzolare, R. A. Nucl. Technol.; 20: No. 3, 140-148(Dec 1973).

In an arid climate, the consumptive use of water by a steam power plant may place a constraint on the plant size and location, and may affect the choice of nuclear or fossil fuel. To estimate the water consumption resulting from the use of recirculating evaporative cooling systems, mathematical models of a cooling tower, cooling pond, and cooling pond with a supplemental spray system were developed, based on meteorological phenomena. The monthly and annual evaporation was then computed using climatological data. The use of a spray system to reduce the required cooling pond surface area is found to be feasible and effective in reducing the evaporation resulting from cooling pond operation. (auth)

Reactor Theory and Calculation

Refer also to abstract 9419.

9505 (AEEW-R-862) WIMS'E' MODULE W-PIJ: A TWO DIMENSIONAL COLLISION PROBABILITY CODE WITH GENERAL BOUNDARY CONDITIONS. Anderson, D. W. (UKAEA Reactor Group, Winfrith, Atomic Energy Establishment). Sep 1973. 79p. Dep. NTIS (U. S. Sales Only) $6.00.

The WIMS'E' module W-PIJ is an extension of the earlier stand-alone version of PIJ later incorporated into the WIMS D code. It evaluates multigroup first collision probabilities in complicated two-dimensional geometries which are assumed infinite in the axial direction and modifies these to take account of the environment in which the system lies by the use of generalized albedo and surface reciprocity arguments. These probabilities are then used in the numerical solution of the integral form of the transport equation. A comprehensive description of the code covering the derivation of the basic equations, the numerical method used, together with details of the geometries treated and the input data required is presented. Users are recommended to read the report in conjunction with the WIMS'E' Users Manual. W-PIJ is Module No. 17 in the scheme. (auth)

9506 (CEA-N-1645) MORET: MONTE CARLO CODE FOR THE RAPID COMPUTATION OF EFFECTIVE MULTIPLYING FACTORS OF FISSILE MEDIA IN COMPLEX GEOMETRIES. Caizergues, R.; Mariot, J. P.; Moret-Bailly, J.; Poullot, G.; Teillet, J. R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). Aug 1973. 164p. (In French). Dep. NTIS (U. S. Sales Only) $10.25.

The MORET code uses the Monte Carlo technique and the multi-group transport theory to determine effective multiplying factors. Complex geometries can be rapidly treated: the array to be studied is divided into simple elementary volumes (spheres, cylinders, boxes, cones, etc) to which set theory operators are applied. (auth)

9507 (CONF-731112-6) RESULTS IN THE APPLICATION OF PATTERN RECOGNITION METHODS TO NUCLEAR REACTOR CORE COMPONENT SURVEILLANCE. Gonzalez, R. C.; Fry, D. N.; Kryter, R. C. (Oak Ridge National Lab., Tenn. (USA)). 1973. 8p. Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

Pattern recognition methods were applied to analyze and interpret neutron noise data from the High Flux Isotope Reactor (HFIR) at ORNL. The results show that it is feasible to detect some core component failures by means of machine-discernible differences in the time-dependent noise power spectra. These neutron spectra (signatures) were analyzed by using a cluster-seeking algorithm to derive a set of templates for automatic computer evaluation of the reactor's mechanical integrity and soundness. (auth)

9508 (CONF-731112-7) EXPERIENCE WITH A DIGITAL NOISE ANALYSIS SYSTEM IN SUBCRITICALITY MEASUREMENTS ON A MOCKUP OF THE FFTF. Pare, V. K.; Kryter, R. C.; Mihalczo, J. T. (Oak Ridge National Lab., Tenn. (USA)). 1973. 9p. Dep. NTIS $3.00.

From nuclear science symposium; San Francisco, California, USA (14 Nov 1973).

A digital Fourier analyzer was programmed to perform reactor neutron noise analysis measurements and on-line processing of the data to obtain the steady-state reactivity. The system is suitable for recovering cross spectral density with low correlated-signal component and for repetitive measurements with efficient use of reactor time. (auth)

9509 (FEI-354) TWO-DIMENSIONAL CALCULATION OF THE CRITICALITY OF A REACTOR. Matveenko, V. I.; Shulepin, V. S. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk. Fiziko Ehnergeticheskij Inst.). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

9510 (IAE-2242) MEASUREMENT OF SPECTRAL INDICES IN A URANIUM-WATER LATTICE WITH FUEL ELEMENTS OF A VVER (WATER COOLED POWER REACTOR). Aborina, I. N.; Komissarov, L. V.; Lunin, G. L. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Atomnoj Ehnergii). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

9511 (KFKI-73-47) RJG5-THERESA CODE SYSTEM OF THE NEUTRON SPECTRUM CALCULATING CODES: THERMOS, GRACE, AND RIFFRAFF. Gado, J. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Oct 1973. 42p. Dep. NTIS (U. S. Sales Only) $4.25.

The RJG5-THERESA code system is the summary of the already existing codes THERMOS, GRACE and RIFFRAFF. This calculational system can be applied for the determination of the neutron spectrum in a reactor lattice cell. The description contains all the necessary information needed for the users of the code system. (auth)

9512 (KFKI-73-49) RESONANCE INTEGRAL CALCULATIONS: THE CODES RYF4-RIFFRAFF AND RYF5-RIFFHOM. Status Report. Gado, J.; Szatmary, Z. (Kozponti Fizikai Kutato Intezet, Budapest (Hungary)). Sep 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The status report on the computer codes RYF4-RIFFRAFF and RYF5-RIFFHOM deals with the recent developments of resonance integral calculations. The main topics are the organizational changes in the RIFFRAFF code; the new version of RIFFRAFF for the calculation of homogeneous resonance integrals; the first steps of systematic test of RIFFRAFF calculations to experimental results and the new simple user's manual of the codes. (auth)

9513 (RCN-192) ERROR ANALYSIS OF NEUTRON CAPTURE GROUP CROSS SECTIONS FOR FAST REACTORS, APPLIED TO FISSION PRODUCTS. Dragt, J. B.; Gruppelaar, H. (Stichting Reactor Centrum Nederland, Petten (Netherlands)). Sep 1973. 59p. Dep. NTIS (U. S. Sales Only) $5.00.

The aim of the report is to calculate the statistical uncertainties in neutron capture group cross sections for fast reactors, as needed for cross section adjustment calculations. Applications are made for the simple RCN-1 fission product capture cross section set, but may be extended to more sophisticated models. The following uncertainties are considered successively: (a) statistical errors in cross sections in the resolved resonance energy region which are due to resonance parameter uncertainties; (b) uncertainties in a 1/v-contribution to the cross section at low energy; (c) statistical errors in cross sections in the unresolved resonance region, where a statistical model is used, due to model parameter uncertainties; (d) errors due to the statistical nature of the model in the unresolved resonance region; (e) errors due to uncertainties in the weighting flux spectra of the energy groups; (f) errors due to shortcomings in the RCN-1 model, which have been estimated by a detailed comparison with the more sophisticated model of the code FISPRO-2 of CNEN, Bologna. In addition, some correlations between data of different isotopes have been calculated. In all cases the covariances of the group cross sections have been determined. Examples of group cross section variances and correlation coefficients are given for two fission product isotopes, as well as for a mixture, for which reactivity worths have been measured in the STEK-reactor of RCN. Some other cross section sets and integral quantities calculated from them are compared with the RCN-1 data and their error margins. Future improvements are indicated. The practical computation of level width fluctuation factors and their errors is considered. In particular a way of attaching a width fluctuation correction to the FISPRO-code is given. 33 references. (auth)

9514 (TRG-Report-2344) CTD: A COMPUTER PROGRAM TO SOLVE THE THREE DIMENSIONAL MULTI-GROUP DIFFUSION EQUATION IN X, Y, Z, AND TRIANGULAR Z GEOMETRIES. Fletcher, J. K. (UKAEA Reactor Group, Risley). May 1973. 23p. Dep. NTIS (U.S. Sales Only) $3.25.

CTD is a computer program written in Fortran 4 to solve the multi-group diffusion theory equations in X, Y, Z and triangular Z geometries. A power print-out neutron balance and breeding gain are also produced. 4 references. (auth)

9515 (UJV-2988-R) SPECTRAL SYNTHESIS METHOD FOR PHYSICAL CALCULATIONS FOR FAST REACTORS. Kujal, B. (Ustav Jaderneho Vyzkumu, Rez (Czechoslovakia)). Jul 1973. 44p. (In Czech). Dep. NTIS (U.S. Sales Only) $4.25.

The use of spectral synthesis method for physical calculations of fast reactors is described. The program MODA-1 based on this method was written for the GEIR computer. By means of this code, one-dimensional diffusion calculations were carried out for a two-zone uranium fuelled reactor of the BN-350 type. Numerical results were compared with results of the standard 26-group diffusion calculation. The comparison indicated the applicability of this method to physical calculations of fast reactors. (auth)

Reactor Components and Accessories

Refer also to abstracts 8256 and 8343.

9516 (AECL-4219) SIMPLEXONE CONTROLLER FOR OPTIMIZATION STUDIES. Molnar, J. T.; Wright, J. H. (Atomic Energy of Canada Ltd., Pinawa, Manitoba. Whiteshell Nuclear Research Establishment). Aug 1973. 37p. Dep. NTIS (U. S. Sales Only) $4.00. AECL $1.00.

SIMPLEXONE is a subroutine which can be used to find the extremum of a function subject to certain inequality constraints. Examples of its use in solving mathematical problems and as a controller for running large computer codes are given. Features of the algorithm are mathematical simplicity and speed. A version of SIMPLEXONE has been implemented in a nuclear engineering costing code to automatically design heat exchangers for a nuclear power station. The use of the controller to operate the code has led to an improved heat exchanger design and significant reduction in human effort and computer time compared to results which were previously obtained by varying design parameters one at a time and submitting jobs for each case. (5 references) (auth)

9517 (EUR-4961) STUDY ON EQUIPMENTS AND METHODS FOR THE SUPERVISION OF WATER–STEAM CIRCUITS IN THERMAL POWER PLANTS. (Commission of the European Communities, Brussels (Belgium); VGB Technische Vereinigung der Grosskraftwerksbetreiber e.V., Essen (F.R. Germany)). Apr 1973. 63p. (In German).

The supervision of water–steam circuits of power plants is described in respect to the selection of parameters to be supervised, the choice of sampling points, and the frequency of analyses to be performed. The problems connected with different sampling techniques are treated. The requirements to be asked from analysis methods are described, taking into account also economical aspects and the automation possibilities. The summary of the methods normally used for the analyses is followed by a report on experiences acquired within the member countries of the Community. The conclusion contains an outlook on future developments. 41 references. (auth)

9518 (EUR-5028) PROGRESS REPORT OF THE EURATOM WORKING GROUP ON REACTOR DOSIMETRY, JULY 1970 TO DECEMBER 1972. Farinelli, U.; Liskien, H. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements). Sep 1973. 24p. Dep. NTIS (U.S. Sales Only) $3.25. EUR B.Fr. 40.-.

The activity of the Working Group on Reactor Dosimetry of Euratom during the period July 1970–December 1972 is described in some detail following the same organization adopted for the previous Progress Report (EUR 4528.e). The state of the art in the field of reactor dosimetry is described as it results both from the information circulated through technical reports and publications and from the discussions held at the five meetings organized during the period covered by the Progress Report. A bibliographic list of all papers forwarded to the EWGRD completes the present text. (auth)

9519 (RDT-E-6-10-T(10-73)) TEMPERATURE AND LIQUID LEVEL CONTROL MONITOR, PORT PLUG (FABRICATION ONLY). (USAEC Division of Reactor Research and Development, Washington, D. C.). Oct 1973. 16p. RSO.

Requirements for fabrication, testing, inspection, cleaning, packaging, delivery, and on-site handling of the mechanical system for a Temperature and Liquid Level Monitor (TLLM) Port Plug Assembly are presented. The TLLM port plug provides access, support, and protection for the plant protection system (PPS) thermocouples and liquid level probes required to measure reactor sodium outlet plenum temperatures and monitor sodium levels within the reactor vessel. Each TLLM assembly consists of three PPS removable thermocouple assembly units and capabilities to accept at least one removable PPS liquid level probe assembly. The TLLM assembly shall consist of but not be limited to closed thimbles to accommodate a dry thermowell temperature sensor and dry inductive coil-type liquid level sensor, respectively. The TLLM is designed to provide an adequate structural, thermal, and paramagnetic environment and primary system boundary seal for the sensors and to minimize radiation streaming into the head compartment. (auth)

9520 (RDT-E-15-2-T(8-73)) REQUIREMENTS FOR NUCLEAR COMPONENTS (SUPPLEMENT TO ASME BOILER AND PRESSURE VESSEL CODE, SECTION III). (USAEC Division of Reactor Research and Development, Washington, D. C.). Aug 1973. 25p. RSO.

9521 TURBINY DIYA ATOMNYKH ELEKTRO-STANTSII. (Turbines for Atomic-Electric Plants). Troyanovskii, B. M. Moscow; Energiya (1973). 184p.

This study is the first attempt to reduce to one book the present state of knowledge on turbines for atomic power plants. The first section deals with various types of reactors (light water, heavy water, gas, liquid metal, etc.) and turbine design. The second part deals with blade design for high-, intermediate- and low-pressure steam. Particular attention is devoted to the aerodynamics of flow through the turbine, especially, in the low-pressure stages of the turbine. Regenerative heating of the feed water is treated. The third section deals with the basic thermodynamic characteristics of moist steam, the flow of moist steam in turbine lattices, and the effect of moisture content on the characteristics of the turbine stage. Part 4 deals with turbine design based on saturated steam. Attention is paid to the separation of condensed steam. Prevention of erosion to the operating blades is covered. Turbine construction in various countries is covered in Part 5. Various methods of controlling turbines is treated in Part 6. 176 references. (SJR)

9522 DYNAMIC RESPONSE OF PIPING SYSTEMS OF NUCLEAR POWER PLANTS TO SEISMIC EXCITATION. Pierantoni, M. (Progettazioni Meccaniche Nucleari, Genoa); Daglio, E.; Reynen, J. pp 297-311 of Metodi di Calcolo e di Prova di Structure Soggette a Vibrazioni. II. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In Italian).

From conference on computation and test methods for vibrating structures; Pisa, Italy (1972).

A calculation procedure for seismic analysis of the piping systems of a nuclear power plant is suggested. The structure examined is a three dimensional piping system connecting some elastic suspended masses. The static analysis and the stiffness of the supporting structures are obtained by the SPADE code. The free vibration eigenvalues of the piping system are then calculated using the DYNAPS code. The eigenvalues are normalized by the EDF code to solve forced vibration problems. A numerical example is reported. (INIS)

9523 SERPENTINIT v ZASHCHITE YADERNYKH REAKTOROV. (Serpentine in Nuclear Reactor Shielding). Egorov, Yu. A. Moscow; Atomizdat (1973). 239p.

The physical, mechanical, heat-physical, thermal, vibration, shielding, and other properties of serpentine and iron-serpentine concretes are described. Because of its high shielding properties serpentine concrete finds wide use in the construction of reactors. The constants and methods of calculation of the shielding from serpentine were reported. Questions on the preparation and installation of concrete in the construction of shields are examined. (tr-auth)

9524 TESTING OF IODINE FILTERS IN NUCLEAR PLANTS. Lanza, S.; Mazzini, M. (Univ., Pisa, Italy). Com. Naz. Energ. Nucl., Notiz.; 19: No. 6, 25-37(Jun 1973). (In Italian).

The characteristics of the various methods for testing the efficiency of filters and ventilation systems used in nuclear plants for the retention of iodine and its volatile compounds are discussed. The development of the equipment and instrumentation systems required for the execution of such tests, as well as the results obtained with the full-scale filter and ventilation system of the TAPIRO Reactor in operation at CNEN's Casaccia Center, is described in detail. Finally, some tentative indications are given as to the criteria of choice among the various experimental methods in relation to the type of testing to be done, suggesting some simple arrangements which could considerably facilitate the execution of periodical efficiency tests on new plants. (auth)

9525 SEALING DEVICE FOR THE ROTATING PLUG OF A NUCLEAR REACTOR. Brandstetter, R. (to Commissariat a l'Energie Atomique). French Patent 2,129,854. 17 Mar 1971. 8p. (In French).

A sealing device for the plug of a nuclear reactor is presented. The plug of this reactor rotates in fixed support connected to a ring positioned above this fixed support and resting on a bearing track. The device is provided with: a friction track around the entire periphery of the upper part of the ring; an annular base part coaxial with the plug and fixed in a leaktight manner to the fixed support of the ring and bearing track, a sealed joint resting on the annular base part and on the friction track of the ring, this part of the device possessing at least one friction ring together with a spring tightening ring and a means of tightening this joint against the friction track during the immobilizing of the plug. (FR)

9526 FREE VIBRATION EIGENVALUES OF A REACTOR CORE SUPPORT. Curioni, S. (CNEN, Bologna); Freddi, A. pp 165-180 of Metodi di Calcolo e di Prova di Structture Soggette a Vibrazioni. II. Rome; Comitato Nazionale per l'Energia Nucleare (1972). (In Italian).

From conference on computation and test methods for vibrating structures; Pisa, Italy (1972).

The vibration modes of a reactor core support, made by two perforated plates connected by orthogonal tubes, are calculated. A mathematical model is developed using the Rayleigh–Ritz method to obtain the equations for the potential and the kinetic energy of the system and the free vibration eigenvalues. Numerical procedures for IBM 7094 computer are also proposed and applied to a calculation example. (INIS)

9527 FUEL ELEMENT GRID SUPPORT FOR NUCLEAR REACTOR. Zinn, W. H.; Lichtenberger, H. V. (to Combus-

tion Engineering, Inc.). US Patent 3,769,159. 30 Oct 1973. Filed date 24 Jun 1968. 4p.

A support grid for the fuel assembly of a nuclear reactor is described, the grid being generally of the egg crate type of construction with the crossed grid plates being of a material having a low neutron absorption cross-section (Zircaloy). Springs to prevent fuel element movement are secured to these grid plates with the springs being of a high nickle alloy steel such that their load carrying capability resulting from stress relaxation during operation of the reactor is greater than would be the case if fabricated of the material of the grid plates. (Official Gazette)

9528 FUEL BUNDLE AND CONTROL ELEMENT ASSEMBLY HANDLING MECHANISM. Schukei, G. E. (to Combustion Engineering, Inc.). US Patent 3,768,668. 30 Oct 1973. Filed date 17 Dec 1971. 6p.

A novel fuel bundle and control element assembly handling mechanism of a unitary construction is described. Mounted on the fuel lifting assembly of a refueling machine is a hydraulic control element assembly holding mechanism. A fuel bundle grapple mechanism passes through the fuel lifting assembly and is independently, vertically controllable with respect to the lifting assembly from a location on the refueling machine. Thus, the control element assembly and the fuel bundle may be gripped and manipulated independently, yet due to the interrelation of the grapple mechanisms, the control element assembly can be made to remain within the refueling machine lifting assembly during the refueling process. (Official Gazette)

Reactor Fuels

Refer also to abstracts 7551, 7685, 8184, 8193, 8196, 8222–8228, 8239, 8241–8244, 8246, 8247, and 8391.

9529 NUCLEAR FUEL ELEMENT. Masetti, W. R. (to United Nuclear Corp.). US Patent 3,759,243. 18 Sep 1973. Filed date 25 Mar 1970. 6p.

A nuclear reactor fuel element in tubular form and closed at both ends has at least one chamber for receiving gaseous fission products through pressure-responsive entrance means, the remainder of the fuel element tube being approximately filled with fissionable material. The pressure within the fueled portion of the element rises quickly to approximately the operating pressure of the reactor in which the fuel element is installed and remains approximately at that pressure throughout the life of the fuel element. This is accomplished by admitting gaseous fission products to the chamber whenever, during the operating life of the element, the pressure rises to the predetermined pressure to which the entrance means is responsive. (Official Gazette)

Reactor Control Systems

Refer also to abstract 8189.

9530 (AGC-2277(Vol.1)(Bk.1)) RADIATION EFFECTS DATA BOOK. Volume 1. Radiation Effects. (Aerojet General Corp., Azusa, Calif. (USA)). 30 Sep 1964. Contract SNP-1. 356p. Dep. NTIS $20.00.

Declassified 28 Aug 1973.

The Radiation Effects Data Book, Volume I, contains a summary of the irradiation tests conducted by Aerojet-General Corporation and Westinghouse Astronuclear Laboratory. The intent of this Data Book is to document the NERVA Radiation Effects Program in such a manner as to present the status of the Radiation Effects test portion of each NERVA component development program. The text includes a description of the NERVA radiation environment for each component tested, a pre-irradiation evaluation of the component relative to anticipated radiation effects, a discussion of the radiation tests performed on the components, and an evaluation of the test results. (auth)

9531 (AGC-2277(Vol.1)(Rev.)) RADIATION EFFECTS DATA BOOK. Volume I. Radiation Effects. (Aerojet General Corp., Azusa, Calif. (USA)). 30 Apr 1965. Contract SNP-1. 254p. Dep. NTIS $14.75.

Declassified 28 Aug 1973.

Revised irradiation tests data are presented for NERVA reactor components. The irradiation tests were performed on reactor control system components, instrumentation, support structures, and propellant feed system. (DCC)

9532 (CONF-721006-P1, pp 350-357) CONTROL ROD MECHANISMS FOR FAST REACTORS. Delemontey (Groupement Atomique Alsacienne Atlantique, Le Plessis Robinson, France); Palomo; Jacomy; Savary; Maulard; Michot. 1973. (In French).

From international conference on engineering of fast reactors for safe and reliable operation; Karlsruhe, Federal Republic of Germany (9 Oct 1972).

The specific problems encountered with fast reactors cooled by liquid sodium are listed and analyzed. They are strongly linked with the environment and the performance required. Ambient conditions limit the choice of materials and of element mechanisms which can be used. The mechanisms should occupy as little space as possible so that they can be installed and dismantled on a packed lattice which is determined by the reduced core dimensions. The requirements as to performance are stringent, depending on the precision of positioning, time in the core, satisfactory operation under extreme conditions of irregular alignment (differential dilatations, deformation in the flux, earthquakes), and number of permissible cycles without maintenance. (auth)

9533 (GKSS-72/E/18) FRG-O-II EXPERIMENT. Baumgart, R.; Besser, H.; Boessow, E.; Doose, R.; Herr, M.; Krull, W.; Martens, P.; Wrobel, H. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F.R. Germany)). 1972. 61p. (In German). Dep. NTIS (U. S. Sales Only) $5.25.

In the 7th status report of the FRG-O-II experiments, the measurements of the thermal neutron flux distribution on the complex nuclear charge 22 are reported. In particular, the dependence of the maximum permissible reactor capacity on the shimming programme has been examined. The reactivity worths characterizing the nuclear charge 22 are given. The flow rate was measured on a dummy and the trajectories for disturbances were measured for the development of new plate shimming rods. The first measurements for the determination of β_{eff} were carried out. The temperature coefficient for various nuclear charges was also determined. (GE)

9534 (GKSS-73/E/8) MEASUREMENT OF THE MICRO BURNUP OF THE SOLID NEUTRON ABSORBERS BORON AND CADMIUM. Motamedi, K. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht-Tesperhude (F. R. Germany)). 1973. 65p. (In German).

In the "Neunerbuendel (niner-bundle)" experiment at the FRG-1 reactor, the burnup of solid neutron absorbers ("poisons") as well as the fuel burnup has been investigated at highest possible neutron flux, and compared with the theoretical calculated values. In the model fuel elements used, eight enriched uranium fuel rods quadratically surround a poison rod, which in the given experiment contains 4.6% natural boron (with 19.8% ^{10}B) or 38% natural cadmium (with 12.26% ^{113}Cd). Between the irradiation runs, the fluence (by co-activation), fuel burnup (by gamma spectroscopy), reactivity and poison burnup have been measured, the latter by measuring the transmission of slow, practically mono-energetic neutrons, following Bragg reflection on an aluminium single crystal, whose energy is determined by a 1/v absorber transmission. The calculated neutron absorption cross section of the poisons, for known neutron energies together with the place dependent measured neutron transmission gives the poison atom density distribution over the irradiated sample. These are graphically represented for various fluence values and compared with the theoretical results. As well as a description of the measuring methods, the reactivity as a function of time of a reactor having fixed built-in poison is theoretically dealt with. (GE)

9535 (HEDL-TME-73-4(Vol.1)) HEDL QUARTERLY TECHNICAL REPORT, APRIL, MAY, JUNE 1973. Volume I. Materials Technology. Evans, E. A. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1973. Contract AT(45-1)-2170. 181p. AT.

The fabrication, irradiation testing, and reprocessing procedures for FFTF fuel elements are described. The operation of the PAL facility for the development of liquid sodium purification and cover gas system equipment is reviewed. Nuclear materials management procedures during the reprocessing of PuO_2 are described. The development and irradiation testing programs for FFTF control elements are presented. (DCC)

9536 (HEDL-TME-73-81) EROSION OF BORON CARBIDE BY FLOWING SODIUM. Bunnell, L. R.; Baker, D. E. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1973. Contract AT(45-1)-2170. 43p. AT.

Two tests were conducted in which boron carbide pellets were exposed to flowing sodium at 1100°F to estimate the erosion which could occur in pellets exposed to sodium if FTR control pins were defected. During the first test, unirradiated pellets plus sibling pellets which had been irradiated in a fast flux to 6×10^{20} captures/cc in the BCM-1 experiment were exposed to sodium flowing at 1 ft/sec. In the second test, identical pellets plus additional pellets irradiated to 20×10^{20} captures/cc were exposed to sodium at 5 ft/sec. During the first test, the erosion rate over the exposed surface area averaged 4.72 mg/(cm^2 100 hr) for unirradiated pellets

and 28.30 mg/(cm² 100 hr) for 6×10^{20} captures/cc irradiated pellets. In the second test, the erosion rate was 6.54 mg/(cm² 100 hr) for unirradiated pellets, 38.94 mg/(cm² 100 hr) for 6×10^{20} captures/cc pellets, and 47.44 mg/(cm² 100 hr) for 20×10^{20} captures/cc pellets. These erosion rates were measured at the maximum flow velocity and temperature expected in the FTR. No particles were retained during the first test in which a 7-micron filter was used for collecting eroded material. During the second test, particles were found on a 15-micron collection filter. These particles had an average diameter of about 0.0012 inch. The boron carbide not retained is assumed to have been reduced to subgrain size particles or dissolved in the system sodium. ^{54}Mn was detected in the loop sodium indicating the presence of B_4C beyond the filter. No deleterious effects were found to be caused in the loop. Over the range of flow, temperature, and irradiation exposure considered in these experiments, the erosion of boron carbide was quite low for sodium conditions typical of the FTR. Particles of boron carbide eroded from the pellets are considered to be too small to cause abrasion problems in the FTR coolant system. (auth)

9537 (TIM-868) STATUS OF CONTROL DRIVE DEVELOPMENT IN SUPPORT OF PWAR-20. Shuford, S. C.; Flynn, J. T.; Zigmond, E. J. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 1 Dec 1964. Contract AT(30-1)-2789. 14p. Dep. NTIS $3.00.

Declassified 31 Aug 1973.

The present SNAP-50/SPUR power plant development program concentrates on a system designed for unattended operation in space for 10,000 hours which produces a net electrical output of 300 kW(e). The reactor and shield for this power plant have been designated as the PWAR-20. The status of control drive development work conducted to date in support of the PWAR-20 is summarized. (auth)

9538 (UNI-SA-2) EX-REACTOR CONTROL ROD TESTING USING A ^{252}Cf SOURCE. Toffer, H.; Pursley, D. L. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 13 Jul 1973 Contract AT(45-1)-1857. 17p. (CONF-731101-30). Dep. NTIS $3.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum and Nuclear Energy Exhibition; San Francisco, California, USA (11 Nov 1973).

The control rod replacement program at the Hanford N Reactor required extensive testing of the 94 new rod tips to assure that they were a satisfactory replacement for the original rods in the reactor. A series of mechanical and chemical tests were carried out to assure that the control rod cavities were packed with the prescribed density of B_4C. Some of the control rod tips were x-rayed to test for any possible void regions or foreign material inclusions. As a final ex-reactor test, the neutron absorption characteristics for all the replacement rods were compared with the original control rod tips using epithermal neutrons from a ^{252}Cf source. (auth)

9539 CONTROLS AND INSTRUMENTATION FOR SHIMANE NUCLEAR POWER STATION. Yanai, K. (Hitachi Ltd., Tokyo). Hitachi Hyoron; 55: No. 8, 827-832(Sep 1973). (In Japanese).

The safety criterion imposed on nuclear power plants is much more stringent than for conventional power plants. In fact, no failure whatsoever is considered permissible for reactors or for protective devices for reactors. The controls and instrumentation for a BWR-type nuclear power plant are described with specific reference to the control equipment for the Shimane Nuclear Power Station, Chugoku Electric Power Co. Quality control at the power plant is also discussed. (auth)

9540 INSTRUMENTATION AND CONTROL FOR NUCLEAR POWER STATION. Hiroyoshi, H. (Hitachi Ltd., Tokyo); Suzuki, M. Hitachi Hyoron; 55: No. 8, 823-826(Sep 1973). (In Japanese).

The instrumentation and control system for nuclear power plants of BWR type, ATR (Advanced Thermal Reactor) type, and FBR (Fast Breeder Reactor) type is described. Its features are also introduced. (auth)

9541 RAPIDLY REFUELABLE NUCLEAR REACTOR. Frisch, E.; Andrews, H. N. (to Westinghouse Electric Corp.). US Patent 3,766,006. 16 Oct 1973. Filed date 8 Jul 1970. 8p.

A nuclear reactor is described in which the control rods are held withdrawn or retracted from the fuel by a permanent magnet during refueling. The reactor includes a missile shield which restrains the control rod units from being ejected upwardly during normal operation of the reactor. During refueling the shield is retracted. During normal operation the control rods, when withdrawn, are held by an electromagnet whose coil may be readily deenergized for rod insertion at any time. During refueling the retraction of the shield causes a permanent magnet to replace the electromagnet core. (Official Gazette)

9542 INSTALLATION FOR MEASURING AND CONTROLLING A NUCLEAR REACTOR. Brecy, J. (to Framatone). US Patent 3,769,156. 30 Oct 1973. Filed date 30 Aug 1971. 6p.

An installation for measuring and controlling a nuclear reactor of which the core is situated in a pressurized reactor vessel surrounded by a shielding enclosure, comprises measuring apparatus which is situated in a measuring room outside the shielding enclosure and at a level below that of the opening plane of the vessel, the apparatus being connected to movable detectors each displaceable inside a guide tube capable of penetrating into the core by sliding in a channel, each channel being connected at one end to the vessel bottom and at the other end leading into the measuring room, the other end of each channel including a device which is capable of providing an adjustable seal between the inner surface of the channel and the outer surface of the associated guide tube. (Official Gazette)

Nuclear Power Plant Economics

Refer also to abstract 9646.

9543 (HIT-501) SURVEY OF NUCLEAR POWER SUPPLY PROSPECTS. (Hittman Associates, Inc., Columbia, Md. (USA)). Feb 1972. 98p. (PB-209-283).

A detailed review of the nuclear segment of the power industry and an evaluation of the ways in which nuclear power will impact on national air quality and emissions from fossil-fueled steam electric plants are presented. Electrical power from nuclear-fueled reactors will continue to grow at a substantial rate and will ultimately supply a major portion of electrical power in the United States. The development and use of nuclear plant will directly affect the use of fossil fuels to supply electrical power and will also directly affect the amounts of combustion products released to the environment. Forecasts of the proportion of nuclear power, and thus of fossil-fueled power, vary widely although the majority of forecasts are in reasonable agreement through about 2020. The forecast of future power supplied by nuclear reactors has been shown by optimization analysis to be strongly dependent upon the reactor types and their technological development. Depending on the placement in service of various reactor systems, the emissions of sulfur dioxide and other pollutants to the atmosphere may vary by a factor of 10 within the next 80 years independent of the allowable limits of emissions or fuel contents. Fossil-fueled generating plants will continue to produce power at levels equal to or greater than 1970 levels for the next 80 years. Therefore, emission reductions can only be achieved through control devices or fuel modifications to remove undesirable emissions from effluent gases. Light water reactors will provide the bulk of nuclear-fueled power through the next 15 years, although some use of advanced converter nuclear systems is projected, notably in the High-Temperature Gas-Cooled Reactor System. Breeder reactor technology will develop sufficiently in the next decade to enable utilities to place breeder reactors in commercial service by the middle of the next decade. Fusion reactor systems are currently under development but are not expected to become commercially feasible for the production of electrical power before the first decade of the next century. (auth)

9544 (JUL-966-RG) INDUSTRIAL EFFORTS AND POSSIBILITIES OF HIGH-TEMPERATURE-REACTORS IN CHEMICAL INDUSTRY UNDER CONSIDERATION OF TECHNICAL, ECONOMICAL, AND ECOLOGICAL ASPECTS. Engelhardt, H. R. (Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Reaktorentwicklung). Jun 1973. 207p. (In German). Dep. NTIS (U.S. Sales Only) $12.50.

Thesis.

The possibilities of using nuclear high temperature reactor power stations for the chemical industry of the BRD are estimated for the decade 1980–1990. This consideration includes the secondary energy forms needed by the chemical industry. It is shown that it is completely possible to couple a chemical plant to a HTR nuclear power station by suitable dimensioning of the production spectrum and production volumes. The possible reductions for cost of production or for cost of manufacturing for 34 chemical products are determined by a precise distribution of energy and non-energy costs. The ecological consequences of using nuclear power instead of the usual fossil energy sources are considered. (auth)

9545 (NP-tr-1949) PATTERN OF THE NUCLEAR ELECTRICITY GENERATING INDUSTRY IN THE 1970's AND 1980's. Mandel, H. Translated by G. H. Wheelhouse from Atomwirt., Atomtech.; 18: No. 1, 18-24(1973). 14p. Dep. NTIS (U. S. Sales Only) $3.00.

Taking the Federal Republic of Germany as an example the probable development of the electricity consumption and the in-

creasing proportion of nuclear energy in covering this demand are shown and justified. The conclusions drawn are extended to the USA, EEC countries (6), the United Kingdom and France. Light water reactors will in the first place play the most important role in this connection on account of their low capital costs as compared to other types of reactors, their advanced development and the higher industrial potential behind them. In order to be able to use the advantages of nuclear energy, a closer international cooperation is essential among manufacturers, operators, and licensing authorities combined with an opening of the markets in question. To achieve this aim the initial steps must be taken at the present time, i.e., during the introduction of new reactor types such as the LMFBR, HTR and GBR, while allowing for as wide a competition as possible on the national and international markets if a cheap generation of electricity is to be assured for the future. (auth)

9546 (TID-26241) NUCLEAR POWER PLANT DESIGN ANALYSIS. Sesonske, A. (Purdue Univ., Lafayette, Ind. (USA)). 1973. 488p. Dep. NTIS $10.60.

Information concerning the engineering aspects of the design of commercial nuclear power plants is presented. Topics discussed include: electric utility economics; nuclear plant economics; thermal-transport systems and core design; nuclear analysis methods; safety requirements; fuel-system analysis; design considerations; and optimization approaches. (DCC)

9547 (TRG-Report-2285) DISCOUNT G: A DIGITAL COMPUTER CODE FOR ASSESSING THE ECONOMICS OF NUCLEAR POWER. Iliffe, C. E. (UKAEA Reactor Group, Risley). Jun 1973. 222p. Dep. NTIS (U. S. Sales Only) $13.00.

DISCOUNT G is for simulating an electricity generating system consisting of both nuclear and conventional stations. It may be used to calculate the present worth of expenditure of the system so that the economic benefit of replacement of one type of station by another can be determined as well as its effect on U and Pu logistics. The model includes four different types of nuclear station, four U-feed and two Pu-feed, and one conventional station. The output from the code quotes results from year to year for each type of station, including number of stations installed, load factors, cash flows, and Pu stocks. The code also supplies a summary outfit which gives the discounted expenditure, the discounted capacity commissioned, the fixed and running components of the mean present worth generating cost, and the discounted mean load factor, for each type of station. (10 references) (UK)

9548 STATUS OF WORLDWIDE NUCLEAR POWER PLANTS AS OF MARCH 31, 1973. Com. Naz. Energ. Nucl., Notiz.; 19: No. 6, 75-80(Jun 1973). (In Italian).

Information on the electric power producing potential of nuclear power plants in the U.S. and foreign countries is presented in tables which indicate: the output of plants put in operation during 1953 to 1973; the output of plants under construction for completion during 1976 to 1983; total output of nuclear power plants currently in operation, under construction, or planned in each of 26 countries; output from specific reactor-type power plants in each U.S. state and foreign country; percentage of total nuclear power produced by each reactor-type power plant; and the total worldwide electric power production from nuclear power plants as of 28 Feb 1973. (LCL)

Reactor Fuel Cycle Economics

Refer also to abstracts 8393, 9320, and 9646.

Reactor Licensing and Regulation

Refer also to abstracts 9432 and 9433.

9549 (AAEC/LIB/Bib-396) QUALIFICATIONS AND TRAINING FOR NUCLEAR POWER PLANT PERSONNEL. A Bibliography, 1959 to 1972. Geue, P. J. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jun 1973. 39p. Dep. NTIS (U. S. Sales Only) $4.00.

One hundred and sixty-seven references are arranged alphabetically by the author within each year under the headings: problems of education and training for nuclear power plant personnel; in-service training for reactor operation; and use of simulators for operator training in nuclear power plants. (AT)

9550 (DOCKET-50010-203) DRESDEN NUCLEAR POWER STATION, UNIT 1. Report of a Calibration Drift in Two Channels of the Reactor Power Range Monitor. (Commonwealth Edison Co., Chicago, Ill. (USA)). 16 Nov 1973. 2p. Dep. NTIS $3.00.

9551 (DOCKET-50155-179) BIG ROCK POINT NUCLEAR PLANT. Abnormal Occurrence Report No. AO-14-73: Shutdown Margin Testing Commenced Prior to Conducting the Required Neutron Monitoring System Checks. Abnormal Occurrence Report No. AO-15-73: In-core Monitors Had Not Been Calibrated As Required. (Consumers Power Co., Jackson, Mich. (USA)). 14 Nov 1973. 2p. Dep. NTIS $3.00.

9552 (DOCKET-50213-244) HADDAM NECK PLANT. Abnormal Occurrence Report No. AO-73-10: Failure of the Power Supply for the 480V Motor Control Center Number 5. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 9 Oct 1973. 1p. Dep. NTIS $3.00.

9553 (DOCKET-50213-245) HADDAM NECK PLANT. Abnormal Occurrence Report No. 73-11: Unplanned Release of Radioactive Material. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 13 Nov 1973. 3p. Dep. NTIS $3.00.

9554 (DOCKET-50219-347) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Abnormal Occurrence: Hydraulic Shock and Sway Arrestor Failure. (Jersey Central Power and Light Co., Morristown, N. J. (USA)). 13 Nov 1973. 3p. Dep. NTIS $3.00.

9555 (DOCKET-50220-191) NINE MILE POINT NUCLEAR STATION, UNIT 1. Abnormal Occurrence: A Reactor Low Water Level Switch Setting was Found to Actuate Above the Normal Set Point. (Niagara Mohawk Power Corp., Syracuse, N. Y. (USA)). 19 Nov 1973. 2p. Dep. NTIS $3.00.

9556 (DOCKET-50237-416) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Final Environmental Statement. (Commonwealth Edison Co., Chicago, Ill. (USA)). Nov 1973. 431p. (DOCKET-50249-313). Dep. NTIS $23.75.

The environmental effects of construction and operation of the Dresden Nuclear Power Station Units 2 and 3 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (JWR)

9557 (DOCKET-50237-420) DRESDEN NUCLEAR POWER STATION, UNIT 2. Special Report No. 34, Fuel Performance Report, Cycles I-III. (Commonwealth Edison Co., Chicago, Ill. (USA)). 13 Nov 1973. 23p. Dep. NTIS $3.25.

Information concerning operating experience, off-gas activity, and inspections pertaining to the fuel in Dresden-2 since initial operation is presented. (FS)

9558 (DOCKET-50237-421) DRESDEN NUCLEAR POWER STATION, UNIT 2. Unusual Event: Malfunction of LPCI System MO Valve 1501-3A. (Commonwealth Edison Co., Chicago, Ill. (USA)). 21 Nov 1973. 2p. Dep. NTIS $3.00.

9559 (DOCKET-50247-151) INDIAN POINT STATION, UNIT 2. Notification of Incident: A Crack in the 18-Inch Feedwater Pipe to Steam Generator No. 22 Resulted in the Discharge of Water and Steam to the Containment Vessel. (Consolidated Edison Co. of New York, Inc., New York (USA)). 14 Nov 1973. 2p. Dep. NTIS $3.00.

9560 (DOCKET-50249-314) DRESDEN NUCLEAR POWER STATION, UNIT 3. Potential Hairline Cracks in Fuel Assembly Lower Tie Plates. (Commonwealth Edison Co., Chicago, Ill. (USA)). 5 Nov 1973. 2p. Dep. NTIS $3.00.

9561 (DOCKET-50249-320) DRESDEN NUCLEAR POWER STATION, UNIT 3. Abnormal Occurrence: HPCI System High Steam Flow Isolation Switches Out of Calibration. (Commonwealth Edison Co., Chicago, Ill. (USA)). 20 Nov 1973. 2p. Dep. NTIS $3.00.

9562 (DOCKET-50255-206) PALISADES NUCLEAR PLANT. Monthly Primary and Secondary Radioactivity and Effluent Report, September and October 1973. (Consumers Power Co., Jackson, Mich. (USA)). 12 Nov 1973. 5p. Dep. NTIS $3.00.

9563 (DOCKET-50259-186) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO 7319W: Failure of the Reactor Cleanup System Valve PCV-69-12. (Tennessee Valley Authority, Chattanooga (USA)). 10 Oct 1973. 2p. Dep. NTIS $3.00.

9564 (DOCKET-50259-224) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Abnormal Occurrence Report BF EAO-7344W-7348W: Fish Impingement Estimates.

(Tennessee Valley Authority, Chattanooga (USA)). 9 Nov 1973. 3p. Dep. NTIS $3.00.

9565 (DOCKET-50259-227) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Environmental Occurrence Report BF EAO-7349W-7352W. (Tennessee Valley Authority, Chattanooga (USA)). 16 Nov 1973. 3p. Dep. NTIS $3.00.

9566 (DOCKET-50259-230) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO-7334W: RCIC and HPCI Systems Inoperability During Complete Loss of Plant a-c Electrical Power. Tennessee Valley Authority, Chattanooga (USA)). 19 Nov 1973. 3p. Dep. NTIS $3.00.

9567 (DOCKET-50259-231) BROWNS FERRY NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence Report BFAO 7335W: A Plant Modification Was Made Which Eliminated High Water-Level Initiation of MSIV Closure When Not in the Run Mode. (Tennessee Valley Authority, Chattanooga (USA)). 21 Nov 1973. 2p. Dep. NTIS $3.00.

9568 (DOCKET-50261-276) H. B. ROBINSON PLANT, UNIT 2. Abnormal Occurrence: Error in the Determination of Thimble Factors. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 29 Oct 1973. 3p. Dep. NTIS $3.00.

9569 (DOCKET-50263-272) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: Failure of Torus Cooling Injection Valve, MO-2008. (Northern States Power Co., Minneapolis, Minn. (USA)). 7 Nov 1973. 2p. Dep. NTIS $3.00.

9570 (DOCKET-50263-277) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence Report: Inadvertent Omission of the Daily Linear Heat Generating Rate Surveillance Tests. (Northern States Power Co., Minneapolis, Minn. (USA)). 21 Nov 1973. 1p. Dep. NTIS $3.00.

9571 (DOCKET-50263-278) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence Report: Violation of Standby Liquid Control Solution Volume-Concentration Requirements. (Northern States Power Co., Minneapolis, Minn. (USA)). 21 Nov 1973. 2p. Dep. NTIS $3.00.

9572 (DOCKET-50266-131) POINT BEACH NUCLEAR PLANT, UNIT 1. Abnormal Occurrence: Dilution of "B" Boric Acid Storage Tank. (Wisconsin Electric Power Co., Milwaukee (USA)). 3 Nov 1973. 3p. Dep. NTIS $3.00.

9573 (DOCKET-50269-171) OCONEE NUCLEAR STATION, UNIT 1. Unusual Event Report UE-73-8: Main Stream Relief Valve Operation, Additional Data. (Duke Power Co., Charlotte, N. C. (USA)). 21 Nov 1973. 1p. Dep. NTIS $3.00.

9574 (DOCKET-50270-134) OCONEE NUCLEAR STATION, UNIT 2. Abnormal Occurrence Report No. AO-73-1: Reactor Building Spray Valves 2BS-1 and 1BS-2 Were Inadvertently Left Closed and the Breakers for the Motor Operators Were Left in the Open Position. (Duke Power Co., Charlotte, N. C. (USA)). 16 Nov 1973. 3p. Dep. NTIS $3.00.

9575 (DOCKET-50271-253) VERMONT YANKEE NUCLEAR POWER STATION. Proposed Rod Select Panel Template System, Additional Information. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 31 Oct 1973. 16p. Dep. NTIS $3.00.

9576 (DOCKET-50271-254) VERMONT YANKEE NUCLEAR POWER STATION. Abnormal Occurrence Report No. AO-73-31: Control Rod Withdrawal Error Resulted in a Reactor Scram. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 14 Nov 1973. 6p. Dep. NTIS $3.00.

9577 (DOCKET-50271-255) VERMONT YANKEE NUCLEAR POWER STATION. Containment Leak Rate Testing. (Vermont Yankee Nuclear Power Corp., Rutland (USA)). 13 Nov 1973. 3p. Dep. NTIS $3.00.

9578 (DOCKET-50277-157) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrences: High Reactor Conductivity and Apparent Failures of Three Reactor Relief Valves. (Philadelphia Electric Co., Pa. (USA)). 9 Nov 1973. 4p. Dep. NTIS $3.00.

9579 (DOCKET-50277-158) PEACH BOTTOM ATOMIC POWER STATION, UNIT 2. Abnormal Occurrence: A Second Failure on the K Reactor Relief Valve Bellows and Two Possible Additional Bellow Failures on Reactor Relief Valves E and L. (Philadelphia Electric Co., Pa. (USA)). 16 Nov 1973. 2p. Dep. NTIS $3.00.

9580 (DOCKET-50280-193) SURRY POWER STATION, UNIT 1. Abnormal Occurrence Report No. AO-S1-73-13: Safety Injection Accumulator Level Transmitter Amplifier Drift. (Virginia Electric and Power Co., Richmond (USA)). 21 Nov 1973. 7p. Dep. NTIS $3.00.

9581 (DOCKET-50282-177) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Abnormal Occurrence: A Pressure Transient Was Caused By A Temperature Differential Which Developed Between the Reactor Vessel and the Steam Generator. (Northern States Power Co., Minneapolis, Minn. (USA)). 9 Nov 1973. 2p. Dep. NTIS $3.00.

9582 (DOCKET-50282-179) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1. Final Report on Valves Within the Reactor Coolant Pressure Boundary Found Below Specified Minimum Wall. (Northern States Power Co., Minneapolis, Minn. (USA)). 23 Nov 1973. 3p. Dep. NTIS $3.00.

9583 (DOCKET-50282-180) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Report on Westinghouse W-2 Switch Malfunction. (Northern States Power Co., Minneapolis, Minn. (USA)). 23 Nov 1973. 2p. (DOCKET-50306-142). Dep. NTIS $3.00.

9584 (DOCKET-50282-182) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Final Report of Loose Impeller Causing Seizing of Safety Injection Pump. (Northern States Power Co., Minneapolis, Minn. (USA)). 23 Nov 1973. 2p. (DOCKET-50306-144). Dep. NTIS $3.00.

9585 (DOCKET-50285-138) FORT CALHOUN STATION, UNIT 1. Abnormal Occurrence Report No. 73-5: Excessive Reactor Coolant System Chloride Content. (Omaha Public Power District, Nebr. (USA)). 6 Nov 1973. 3p. Dep. NTIS $3.00.

9586 (DOCKET-50285-139) FORT CALHOUN STATION, UNIT 1. Data on Dissolution Rate of Trisodium Phosphate Dodecahydrate in Boron Solution. (Omaha Public Power District, Nebr. (USA)). 14 Nov 1973. 6p. Dep. NTIS $3.00.

9587 (DOCKET-50289-142) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Nuclear Service River Water Pump 1B Motor Failure. (Metropolitan Edison Co., Reading, Pa. (USA)). 14 Nov 1973. 3p. Dep. NTIS $3.00.

9588 (DOCKET-50293-202) PILGRIM NUCLEAR POWER STATION, UNIT 1. Unusual Occurrence Report No. 73 16: Inoperability of Residual Heat Removal Valve MO 1001-29B. (Boston Edison Co., Mass. (USA)). 20 Nov 1973. 1p. Dep. NTIS $3.00.

9589 (DOCKET-50295-202) ZION NUCLEAR PLANT, UNIT 1. Abnormal Occurrence: Overtemperature ΔT Trip Point Out of Alibration. (Commonwealth Edison Co., Zion, Ill. (USA)). 10 Nov 1973. 2p. Dep. NTIS $3.00.

9590 (DOCKET-50295-203) ZION NUCLEAR PLANT, UNITS 1 AND 2. Leakage Testing of Containment. (Commonwealth Edison Co., Chicago, Ill. (USA)). 13 Nov 1973. 5p. (DOCKET-50305-127). Dep. NTIS $3.00.

9591 (DOCKET-50295-204) ZION NUCLEAR PLANT, UNIT 1. Abnormal Occurrence: 1B Containment Spray Pump Would Not Start Because 1MOV-CS0009 Did Not Fully Open and Actuate the Necessary Limit Switch for the Test Position. (Commonwealth Edison Co., Zion, Ill. (USA)). 19 Nov 1973. 2p. Dep. NTIS $3.00.

9592 (DOCKET-50305-125) KEWAUNEE NUCLEAR POWER PLANT. Final Report on Pipe Restraint Welds. (Wisconsin Public Service Corp., Green Bay (USA)). 31 Oct 1973. 3p. Dep. NTIS $3.00.

9593 (DOCKET-50305-131) KEWAUNEE NUCLEAR POWER PLANT. Description of the Switch Housing Problem. (Wisconsin Public Service Corp., Green Bay (USA)). 23 Nov 1973. 3p. Dep. NTIS $3.00.

9594 (DOCKET-50309-153) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence Report No. 73-6: Analysis of a Sample Drawn From the RWST Showed a Minor Reduction in Boron Concentration. (Maine Yankee Atomic Power Co., Wiscasset (USA)). 6 Nov 1973. 2p. Dep. NTIS $3.00.

9595 (DOCKET-50309-156) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence No. 73-5: Division Valves RH-8, -9, -10, and -11 Between the LPSI Header and the Containment Spray Header Were in the Open Position. (Maine Yankee Atomic Power Co., Wiscasset (USA)). 5 Nov 1973. 2p. Dep. NTIS $3.00.

9596 (DOCKET-50309-158) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence Report No. AO-73-7: The Electric Governor Control Unit, EG-A, of Diesel Generator (DG-1B) Was Found to Be Faulty. (Maine Yankee Atomic Power Co., Westboro, Mass. (USA)). 16 Nov 1973. 1p. Dep. NTIS $3.00.

9597 (DOCKET-50309-159) MAINE YANKEE ATOMIC POWER PLANT. Abnormal Occurrence Report No. AO-73-7: Electric Governor Control Output Fluctuated Causing Load Oscillation to Occur. (Maine Yankee Atomic Power Co., Westboro, Mass. (USA)). 10 Nov 1973. 1p. Dep. NTIS $3.00.

9598 (DOCKET-50313-115) ARKANSAS NUCLEAR ONE, UNIT 1. Incident Report: Station Inverter Malfunction. (Arkansas Power and Light Co., Pine Bluff (USA)). 31 Oct 1973. 2p. Dep. NTIS $3.00.

9599 (DOCKET-50324-123) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Failure of 125/250 Volt Batteries to Meet Performance Specifications. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 26 Oct 1973. 1p. (DOCKET-50325-122). Dep. NTIS $3.00.

9600 (DOCKET-50324-125) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Design Report No. 17, Diesel Generator Decision Tree and Fault Tree Analysis. (Carolina Power and Light Co., Raleigh, N. C. (USA)). 30 Nov 1973. 217p. (DOCKET-50325-124). Dep. NTIS $3.00.

Decision-tree and fault-tree analyses are presented to show that interaction between Units 1 and 2 will not result in unacceptable consequences for diesel generator loading and related control logic. The analyses indicate two possible categories of interactive failures and concommitant events such as the failure of one or more components, which would exceed single failure design, or the failure of the Standby Electrical Power System based on hypothesized inadequacies in the performance of the diesel-generators when operating within their intended design range. These failures are considered highly unlikely. (FS)

9601 (DOCKET-50329-51) MIDLAND PLANT, UNITS 1 AND 2. Incident Report, Serious Deficiencies Associated With Cadweld Splicing of Concrete Reinforcing Bars. (Consumers Power Co., Jackson, Mich. (USA)). 13 Nov 1973. 2p. (DOCKET-50330-50). Dep. NTIS $3.00.

9602 (DOCKET-50331-125) DUANE ARNOLD ENERGY CENTER. Evaluation of Centerline Shrinkage Cracks in Bosses of Fuel Bundle Lower Tie Plates. (Iowa Electric Light and Power Co., Cedar Rapids (USA)). 14 Sep 1973. 17p. Dep. NTIS $3.00.

9603 (DOCKET-50382-74) WATERFORD STATION, UNIT 3. Additional Information re Calculated Containment Pressure and Subcompartment Pressure Analyses. (Louisiana Power and Light Co., New Orleans (USA)). 21 Nov 1973. 32p. Dep. NTIS $3.75.

9604 (DOCKET-50409-78) LA CROSSE BOILING WATER REACTOR. Abnormal Occurrences Nos. 73-4, 73-5, and 73-6, Amendment. (Dairyland Power Cooperative, LaCrosse, Wis. (USA)). 2 Nov 1973. 2p. Dep. NTIS $3.00.

9605 (DOCKET-50416-59) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Draft Environmental Statement. (Mississippi Power and Light Co., Jackson (USA)). Apr 1973. 301p. (DOCKET-50417-59). Dep. NTIS $17.25.

The environmental effects of construction and operation of the Grand Gulf Nuclear Station Units 1 and 2 are examined. The descriptions include: the environment in the area, including the history, geography, geology, hydrology, climatology, ecology, land and water use including chemical characteristics; the facility and its effluents; the impacts from construction and operation of the facility; alternatives to the proposed action; irreversible and irretrievable long-term commitments of resources from plant operation; need for power; and the benefits-cost analysis of the proposed plant operation. (FS)

9606 (PRDI-73-2) TITLE LISTING OF POWER REACTOR DOCKET INFORMATION, SEPTEMBER–OCTOBER 1973. (USAEC Technical Information Center, Oak Ridge, Tenn.). Nov 1973. 40p. Free.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Atomic Energy Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (DCC)

9607 (PRDI-73-3) TITLE LISTING OF POWER REACTOR DOCKET INFORMATION, NOVEMBER–DECEMBER 1973. (US AEC Technical Information Center, Oak Ridge, Tenn.). Dec 1973. 39p.

Citations and subject indexing to the documentation associated with civilian nuclear power plants are presented. This material is that which is submitted to the Atomic Energy Commission in support of applications for construction and operating licenses. Citations are listed by Docket number in accession number sequence. The Table of Contents is arranged both by Docket number and by nuclear power plant name. (DCC)

9608 (RAI-73-10) REGULATORY ADJUDICATION ISSUANCES, OCTOBER 1973. (USAEC Technical Information Center, Oak Ridge, Tenn.). 15 Nov 1973. 189p.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (DCC)

9609 (TID-26473) PREPARATION OF ENVIRONMENTAL REPORTS FOR NUCLEAR POWER PLANTS. Regulatory Guide 4.2. (USAEC Directorate of Regulatory Standards, Washington, D. C.). 2 Mar 1973. 76p. AEC/W Free.

9610 NUCLEAR SAFETY AND THE MINISTRY OF INDUSTRIAL AND SCIENTIFIC DEVELOPMENT. Servant, J. (Ministere du Developpement Industriel et Scientifique, Paris). Rev. Fr. Energ.; 24: No. 254, 355-360(Jun 1973). (In French).

On March 13, 1973, the Ministry of Industrial and Scientific Development created by decree the Central Service for the Safety of Nuclear Installations responsible for the study, definition, and effecting of the ministerial policy on nuclear safety (accident prevention and the minimizing of their possible effects). This new service plays an essential role in the authorization prior to the construction of basic nuclear installations, and the development of technical legislation concerning these installations and their surveillance. This service provides two complementary services: documentation on problems connected with nuclear installation safety and information for the general public. The important place of the CEA in these matters is discussed. A senior consultant committee was established for nuclear safety issues. (FR)

GENERAL

Energy Utilization and Economics

Refer also to abstracts 7692 and 8183.

9611 (COO-2260-3) ELECTRICAL POWER GENERATION: COMPARATIVE RISKS AND BENEFITS. Final Report, August 6, 1973–August 10, 1973. A One-Week Workshop for High School Science Teachers. Carbon, M. W.; Hartwig, K. T. (Wisconsin Univ., Madison (USA)). 16 Aug 1973. Contract AT(11-1)-2260. 37p. Dep. NTIS $4.00.

A live-in type workshop available for academic credit covering basic nuclear power generation and the tradeoffs and problems that exist between nuclear power and alternative means to generate electricity was held for 37 high-school teachers at the Madison campus for the University of Wisconsin. Significant improvements over last year's program included the distribution of a large amount of information and the distribution of two minicourse outlines on the subject of power and the environment entitled: "The Environmental Impact of Electrical Power Generation: Nuclear and Fossil" prepared by the Pennsylvania State Dept. of Education, and "Science III Matter–Energy Interactions in Natural Systems" prepared by Carl Pfeiffer of Monona Grove High School, Monona, Wisconsin. (MCW)

9612 (LA-5447-MS) ENERGY AND ENVIRONMENT: SYSTEMS AND PERSPECTIVES. Freiwald, D. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1973. Contract W-7405-eng-36. 13p. Dep. NTIS $4.00.

The concept of energy and environment is discussed from various perspectives, including space and time, energy systems development and natural resources, limits to growth, influence systems, the total environment, alternate schemes, and a communications structure. Brief discussions are presented as to how these subjects interrelate, and what types of programs might meaningfully ameliorate energy problems on a long-time scale. (69 references) (auth)

9613 (LA-UR-73-926) POTENTIAL FOR THE PRODUCTION OF POWER FROM GEOTHERMAL RESOURCES. Smith, M. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 18p. Dep. NTIS $3.00.

The nature and magnitude of the hot, dry rock geothermal energy resource are such that within the next 10 to 15 years it could begin to contribute significantly to the solution of some of our nation's most urgent energy, pollution, and balance-of-payments problems. A program to investigate and develop this resource was undertaken by the Atomic Energy Commission at Los Alamos Scientific Laboratory, and initial results from that program are described. It appears that the equipment and techniques required to make this vast energy reservoir useful already exist, and that a convincing demonstration of its usefulness is possible within less than five years. (auth)

9614 (LA-UR-73-1075) POTENTIAL FOR HOT-DRY-ROCK GEOTHERMAL ENERGY IN THE WESTERN UNITED STATES. Brown, D. W. (Los Alamos Scientific Lab., N. Mex. (USA)). 25 Jul 1973. Contract W-7405-eng-36. 22p. Dep. NTIS $3.25.

The U. S. Geological Survey has identified 1.8 million acres (2800 square miles) of western lands as "having a significant potential for geothermal development." The LASL for the past 2 years has been actively investigating the potential for and problems associated with extracting geothermal energy from the much more numerous regions of the western United States containing hot, but essentially dry, rock at moderate depths. A recent survey reveals that about 7% of the 13-state area comprising the Western Heat Flow Province—about 95,000 square miles—is underlain, at a depth of 5 km (16,400 ft), by hot rock at temperature levels above 290°C (>550°F). In the Los Alamos concept, a man-made geothermal reservoir would be formed by first drilling into suitably hot rock, and then creating a very large surface area for heat transfer using conventional hydraulic fracturing techniques developed by the oil industry. After forming a circulation loop by drilling a second hole into the top of the fractured region, the heat contained would be convected to the surface by the buoyant circulation of water, without the need for pumping. The water in the Earth loop would be maintained as a liquid throughout by pressurization at the surface, both increasing the amount of heat transport up the second (withdrawal) hole, and enhancing the rate of heat removal from the fractured reservoir, when compared to steam. Thermal stresses resulting from the cooling of the hot rock in such a man-made reservoir may gradually enlarge the initial fracture system so that its useful lifetime will be greatly extended beyond the planned 10 to 15 years provided by the original reservoir. If these thermal stress cracks grow preferentially downward and outward into regions of hotter rock, as seems probable, the quality of the geothermal source may actually improve as energy is withdrawn from it. (auth)

9615 (LA-UR-73-1316) GEOTHERMAL ENERGY. Smith, M. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1973. Contract W-7405-eng-36. 9p. Dep. NTIS $3.00.

Dry hot rock in the Earth's crust represents the largest and most broadly distributed reservoir of usable energy accessible to man. The engineering equipment and methods required to extract and use this energy appear to exist and are now being investigated actively at LASL. At least for deep systems in relatively impermeable rock, not close to active faults, the extraction of energy from dry geothermal reservoirs should involve no significant environmental hazards. The principal environmental effects of such energy systems will be those associated with the surface facilities that use the geothermal heat; these will be visual, in land use, and in the thermal-pollution potential of low-temperature power plants. The energy extraction system itself should be clean, safe, unobtrusive, and economical. (auth)

9616 (N-73-22748) UTILIZATION OF SOLAR ENERGY TO HELP MEET OUR NATION'S ENERGY NEEDS. Thomas, R. L. (National Aeronautics and Space Administration, Cleveland, Ohio (USA). Lewis Research Center). 1973. 37p. (NASA-TM-X-68230). NTIS.

The nation's energy needs, domestic energy resources, and possible future energy resources are briefly discussed in this paper. Three potential solutions, coal, nuclear, and solar are compared as to benefits and problems. This paper primarily discusses the options available in using solar energy as a natural energy resource. These options are discussed under the generation of electricity, heating and cooling of buildings, and the production of clean fuel. (STAR)

9617 (ORNL-tr-2716) GEOLOGY OF THE IRATI FORMATION. Bigarella, J. J. 1971. Translated by H. S. Pomerance and M. Gerrard From Paper Presented at Conference on Science and Technology of Schist, Curitiba, P. R.; December 12–17, 1971. (CONF-711229-2). 91p. Dep. NTIS $6.75.

From conference on science and technology of schist; Curitiba, Puerto Rico, USA (12 Dec 1971).

In 1957, Petrobras began investigating the Irati formation from the viewpoint of the enormous gas and liquid fuel reserves and the sulfur content in the pyrobituminous layers. Simultaneously with a study of the development of processes for industrialization of the Irati schists (oil shales), the company carried out a detailed investigation of the formation through systematic test drillings accompanied by laboratory studies, which contributed greatly to a better knowledge of its characteristics. The study was to select areas with technical and economic feasibility for industrial use of the oil shales, considering present mining methods and the processing systems developed. Summaries of the general results obtained by Petrobras and the existing published and unpublished information are compared. (97 references) (MCW)

9618 (ORNL-tr-2717) CHEMISTRY OF THE IRATI SHALE. Costa Nito, C. 1971. Translated by R. G. Mansfield and H. S. Pomerance from Paper Presented at Conference on Science and Technology of Schist, Curitiba, P.R., December 12–17, 1971. (CONF-711229-1). 33p. Dep. NTIS $3.75.

From conference on science and technology of schist; Curitiba, Puerto Rico, USA (12 Dec 1971).

The results obtained in the study of the chemistry of Irati shale in the "Projeto Xistoquimica" are presented and discussed. After a description of the objectives, the paper establishes a general scheme for the analysis of shale and then the results obtained in the identification of (a) organic and inorganic chemical components, (b) functional groups, (c) minerals, (d) saturated hydrocarbons, (e) porphyrins, and (f) carboxylic acids. An energy conversion cycle is discussed in which carbon is not consumed. Finally, options are presented for the total recovery of sulfur from shale by oxidation of the pyrolysis residue to sulfur dioxide and subsequent reduction of this by carbon (from pyrolyzed shale), hydrogen, or carbon monoxide (in the presence of pyrolyzed shale). In the first appendix the use of the word "xisto" in Portuguese is discussed and, in the second, the use of symbols in diagrams of the Project Xistoquimica is presented. (auth)

9619 (RISO-M-1670) WHY DOES ENERGY CONSUMPTION INCREASE BY 8.2% PER YEAR? Elbek, B. (Niels Bohr Insti-

tutet, Copenhagen (Denmark)). Nov 1973. 28p. (In Danish). Dep. NTIS (U. S. Sales Only) $3.50.

An analysis is presented of the consumption of energy and its rate of growth in Denmark. On the basis of statistical tables the total consumption (2.1×10^8 gcal in 1972) is divided among major groups of primary users for the period 1900-1972. The consumption of energy (approx. 30% of total) for residential heating is calculated from the number of dwellings, their average size, and the standard of insulation. For the residential consumption of electricity, a complete breakdown is made for the period 1950-1970 in terms of electric appliances that account for the rate of growth of 11% per year. A less-detailed breakdown is made for the industrial use of electricity. The Danish consumption of energy is compared to that of other countries and it is concluded that the growth rate is fairly independent of per capita consumption, economic development, and political system. It is stressed that conservation of energy is best achieved through policies acting on growth rates rather than levels of consumption. (auth)

9620 (SLA-73-1056) PROPOSAL TO NSF FOR SUPPORT OF SYSTEMS ANALYSIS COMPUTER PROGRAM PROPOSED FOR SOLAR COMMUNITY TOTAL ENERGY CONCEPT. Stromberg, R. P.; Edenburn, M. W.; Thunborg, S. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1973. Contract AT(29-1)-789. 26p. Dep. NTIS $3.50.

Sandia Laboratories is proposing that the NSF sponsor a program for the development of a new, more sophisticated systems analysis of solar energy systems. The analysis will be primarily aimed at the solar total energy concept, but it should also be applicable to other solar thermal applications. The effort will require the development of a flexible computer program that will control and manipulate individual component subroutines to determine their impact on the total system. The program will determine solar system costs and fossil fuel savings as compared to those associated with conventional fossil fuel system. (auth)

9621 (SLA-73-6002) HYDRAULIC FRACTURING FOR UNDERGROUND GASIFICATION OF COAL DEPOSITS. Klimentov, P. P. Translated from Izv. Vyssh. Ucheb. Zaved., Geol. Razved.; No. 10, 97-105(1964). 21p. Dep. NTIS $3.25.

Hydraulic fracturing was applied as a possible means of shaftless preparation of coal seams for underground gasification in the USSR at the "Podzemgas" station at Lisichansk in 1953. The initial fracturing agent was air injected under high pressure, but later a trial was carried out on connecting vertical boreholes with an inclined path by breaking through the dividing coal section with water pumped in under pressure. The parameters of variations of the original method were discussed. Practice shows that the effectiveness of hydraulic fracturing of formations depends on the strength properties of the formations and on the technology applied. Results from using various liquids are given. Data include information on water, oil-based fluids, and water and sand combinations. (MCW)

9622 DISTRICT HEATING COULD CUT HEAT LOSS FROM CONDENSING STATIONS. Haag, A. (Molmoe District Heating Utility, Sweden). Energy Int.; 10: No. 11, 24-25(Nov 1973).

A proposed single-pipe district heating system using heat pumps to extract low grade energy from condenser circulating water is described. The release of enormous quantities of heat from all condensing power stations has been ignored. For example, only 32% of the energy available in the fuel for a light-water reactor, is converted to electricity, the only useful product of a nuclear power station. A station with an electrical output of 5,000 MW releases about 10,000 MW of heat that is presently unuseable. The distances between a nuclear power station and the nearest large community are large, and the use of this heat solely for space heating is at present impossible. With the use of the system described, no significant reduction in electricity production occurs when a condensing set is converted to back-pressure operation. (MCW)

9623 DISTANCE IS SOVIET ENERGY WORRY. Energy Int.; 10: No. 11, 41-42(Nov 1973).

The USSR contains abundant resources of primary energy, but the problem deals with the distance of these resources from the industrialized areas. The Soviet Union has about half the world's natural gas reserves, rich oil and hydropower resources, and practically inexhaustible coal deposits. Two solutions to the problem are being studied—construction of a special coal-freight super-railway and generation of electricity at the mine mouth and then transmit it to the Western republics. Then the development of more efficient pipelines and power transmission lines is necessary. The Soviet cooperation in energy production with Western countries and pacts signed with other countries are discussed. (MCW)

9624 HIDDEN VIEW OF PUMPED STORAGE. Energy Int.; 10: No. 11, 44-45(Nov 1973).

The Ludington, Michigan Pumped Storage Project will be the largest facility of its kind in the world. The large man-made reservoir will serve as a 1872 megawatt peaking plant for the production of electrical power. At low demand periods, electrical power supplied from conventional or nuclear plants will pump water from Lake Michigan through large diameter steel penstocks to storage in the reservoir. At peak demand periods, the reservoir water will be released down the penstocks to the powerhouse turbines to produce electricity. The production parameters and assembly of the project are described. The penstocks are buried. (MCW)

9625 ENERGY CONSERVATION AWARDS FOR 1973. Power; 117: No. 11, 21-30(Nov 1973).

Dow Chemical was awarded a citation for energy conservation in 1973 for improvement of industrial power- and steam-generation cycles, and day-to-day surveillance of Btu consumption, in both power and process plants. Moore Products Co. in Philadelphia won the award when it moved to a new plant stressing the preservation of the local ecology and creating a favorable corporate image and assuring a better working environment for its employees by installing a two-stage cascade air-source heat pump capable of providing both heating and cooling simultaneously. Standard Oil of California's Richmond plant applied a steam-trap and steam-leak program with a reduction in steam demand by 250,000 lb/h with a fuel savings of 386,000 bbl/yr. The energy conservation program at Chevrolet-Livonia involved small changes such as the installation of a timer to turn off fan-room lights after two hours, the compressed air-pressure reduced to 90 from 105 psi, and some spray-washer nozzles delivering 2.8 gpm instead of 10, to win the citation. The Public Service Dept. of Burbank, Ca., added a 23-MW gas turbine with a heat-recovery steam generator to its generating system resulting in a combined heat rate of 9700 Btu/kWh compared with 11,000 Btu/kWh originally. (MCW)

9626 1973 ANNUAL PLANT DESIGN REPORT. Power; 117: No. 11, S1-S32(Nov 1973).

The report covers data on performance, physical parameters, and efficiency for 39 fossil-fired central power stations. Steam-turbine, process, generator, and boiler repowering experiences and combinations of these systems are discussed for 36 domestic and 39 foreign gas-turbine systems. Data on oil and gas engines for 292 domestic and foreign power companies are listed and include criteria on capacity, engine characteristics, plant description, and generator information. Performance data of the components in industrial steam generation plants are summarized for 126 plants. Energy conservation is attained by efficient boiler design and operation in industrial steam systems. Heating and cooling for process and comfort are discussed and data are presented for 188 companies. Heat recovery in large and small buildings cuts costs and conserves energy. An analysis is made of the long-term advantages of small multistage turbines. (MCW)

9627 LARGE-SCALE SOLAR POWER VIA THE PHOTOVOLTAIC EFFECT. Loferski, J. J. (Brown Univ., Providence). Mech. Eng.; 95: No. 12, 28-32(Dec 1973).

As a result of the proposal for the possibility of using the photovoltaic cell for large-scale generation of electricity from sunlight, three questions are posed. What area must be covered by solar cells to generate a significant portion of U. S. energy needs? If generated on the surface of the Earth, what methods of energy storage will be used? How much will photovoltaic solar energy conversion systems cost? It is concluded that the area needed is not unreasonable, that methods of energy storage are available, and that there is reason for optimism with respect to reducing the cost for large-scale power generation from sunlight. (MCW)

9628 FEDERAL TAX POLICY AND GEOTHERMAL ENERGY DEVELOPMENT. Finn, D. F. X. 1: No. 3, 39-42(Oct 1973).

The development of geothermal resources in the U. S. is impeded by the Federal tax policies that exist. The present state of tax rules governing utilization of geothermal energy, certain proposed changes in tax laws which would, if enacted, inhibit utilization of geothermal energy, and changes in present tax rules that would encourage utilization of geothermal energy are discussed. A statement by the accounting firm of Coopers and Lybrand is expanded. The accountants in the firm are the most knowledgable in the U. S. on geothermal energy matters, representing firms that have established commercial geothermal production, selling the product, and developing additional markets. (MCW)

9629 WASHINGTON AND THE UTILITIES: WHAT GOVERNMENT SHOULD DO IN THE ENERGY CRISIS. Falck, E. Pub. Util. Fortn.; 92: No. 12, 39-42(6 Dec 1973).

Lessons of the past when the supply of energy was threatened

are discussed. The author was Director of the Office of War Utilities from 1943 to 1945, during which he was asked to forecast the peak electric power requirements that would occur under conditions of full military and civilian mobilization. Conclusions from the lessons learned from the World War II experience are: (1) a staff of individuals who are competent, objective, and dedicated is needed; (2) all relevant information and statistics needed to make major decisions on an objective basis of fact should be available; (3) centralizing authority and responsibility in a single agency that could operate with speed and decisiveness is absolutely necessary; and (4) having in government at a very high level an agency that can perform affirmative functions in beefing up power supply and energy sources is necessary. Such an agency would have the capability of setting national goals, national priorities, and values. (MCW)

9630 ENERGY CONSERVATION BY REDESIGN: WATTS GO UP THE CHIMNEY, THROUGH WINDOWS AND WALLS, AND ARE DISSIPATED UNNECESSARILY IN APPLIANCES. Friedlander, G. D. IEEE (Inst. Elec. Electron. Eng.), Spectrum; 10: No. 11, 36-43(Nov 1973).

The responsibility of energy conservation will rely on the cooperation of all who produce and consume energy from the mining and petroleum recovery to industry, commerce, and domestic consumer. Canada has announced export reduction in order to keep its own reserves, and with the cessation of Arab oil imports conservation must be the top priority if the U. S. is not to become a "have not" nation. Energy features of building design and energy-conserving techniques for buildings are discussed. A description is given for the Westinghouse Electric Corporation's and Pennsylvania Power and Light Company's energy-saving model residences. A discussion on the basic fuel and energy system efficiencies indicates that gas-powered applicances consume more direct energy than similar electrical equipment. Electricity produced from natural gas is inefficient. Gas lamps are still in use in the U. S. and each of these lamps requires about 20 times more energy than its electrical equivalent. The economies in natural-gas savings that could be attained by replacing gas lamps with incandescent bulbs would be enough to heat more than 600,000 homes yearly. (MCW)

9631 CHARACTERISTICS OF SUPERCONDUCTIVE MAGNETIC SUSPENSION AND PROPULSION FOR HIGH-SPEED TRAINS. Ohno, E. Iwamoto, M.; Yamada, T. (Mitsubishi Electric Corp., Amagasaki, Japan). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 5, 579-586(May 1973).

Theoretical analyses are carried out on a magnetic suspension and a linear synchronous motor, both utilizing superconducting magnets. The derived theory is applied to the studies of the high-speed train models. In the suspension system investigated here, the roadbed is equipped with normal conducting coils. The magnetic lift force is found to be pulsating, and a design criterion for eliminating the pulsation components in the lift force is derived. An improved suspension system is proposed, which consists of a "ladder-type conductor" in the roadbed. This new system is investigated theoretically. An end effect of the suspension system is also studied. In the linear synchronous motor, the methods of minimizing reaction forces are derived. The combined magnetic suspension and propulsion system is analyzed. It is found that the influence of the track loops for the suspension on the linear synchronous motor is not very significant. (auth)

9632 FUEL CRISIS: AN ENERGY PEARL HARBOR. Wakefield, S. A. Pub. Util. Fortn.; 92: No. 12, 29-33(6 Dec 1973).

In relation to energy matters the time has come to decide what is essential and what is merely desirable, what can be afforded, and what must be done and what can wait. The author feels that the idea the Nation's present energy problems will somehow be solved and that normal conditions will return to the world oil market in the relatively near future is pure fantasy. In addition to Arab curtailments and the embargo, prices have been advanced. The embargo was an add-on to an already existing crisis produced by a deteriorating domestic oil and gas supply and failure to prepare for long-term energy needs to be met by large-scale development and exploration of oil, gas, coal, oil shale, and nuclear fissionable materials. This need must be met even if normal trade relations resume with the Arab nations. The imperatives are to mine and burn coal; explore and drill for oil and gas, onshore and offshore; build and license nuclear plants; and do all this and more within tolerable environmental restraints emphasizing human environment. (MCW)

9633 CATALYTIC SYNTHESIS GAS MANUFACTURE. White, R. J. (to Chevron Research Co.). US Patent 3,759,677. 18 Sep 1973. Filed date 5 May 1970. 14p.

A process is presented for producing synthesis gas that comprises contacting an organic feed material, containing hydrogen and at least 10 weight percent oxygen and containing less than five weight percent sulfur, with steam in the presence of an alkali metal carbonate catalyst at an elevated temperature. Preferably the feed material is solid waste material, most preferably solid municipal waste. (Official Gazette)

9634 POLLUTION-FREE FUELS. Leas, L. E.; Leas, R. L.; Johnson, C. J. (to Leas Brothers Development Corp.). US Patent 3,769,197. 30 Oct 1973. Filed date 9 Jul 1971. 8p.

The invention relates to the production of fuels from coal and more particularly to the production of desulfurized and pollution-free fuels. It is desirable from an economical standpoint to use coal for producing both liquid and gaseous fuels since coal is relatively inexpensive compared to petroleum crude oil, and is quite abundant in contrast to the rapidly dwindling domestic supply of the petroleum natural resource. One of the biggest drawbacks in using coal as a source for gasoline, or the like, or for gaseous fuels, is its high sulfur content. This problem is of even greater significance today where much emphasis is being placed on improving the environment by reducing air pollution. It is an objective of the invention to provide a process for producing sulfur-free liquid and gaseous fuels from coal in a unitary process. (MCW)

9635 HYDROGENATION OF COAL USING UNREDUCED CATALYST. Johnason, E. S.; Chervenak, M. C.; Wolk, R. H. (to Hydrocarbon Research, Inc.). US Patent 3,769,198. 30 Oct 1973. Filed date 24 May 1972. 6p.

The liquid-phase catalytic hydrogenation of coal to liquid and gas products is improved by the pretreatment of the catalyst with hydrogen, wherein the pretreatment temperatures are limited to about 200 to 400°F. The catalyst is substantially unreduced before startup oil is introduced into the reactor. (Official Gazette)

9636 ECONOMIC EVALUATION OF MHD-STEAM POWER-PLANTS EMPLOYING COAL GASIFICATION. Bergman, P. D.; Plants, K. D.; Demeter, J. J.; Bienstock, D. Report of Investigations 7796. Washington; Dept. of the Interior (1973). vp.

To assess the efficacy and economics of producing power from coal, four open-cycle magnetohydrodynamic (MHD) processing schemes were selected for study. Each involved a different mode of coal combustion and level of gas cleanliness. The options considered were: (1) coal burned in a slagging combustor; (2) suspension gasification with slag removal prior to combustion; (3) parallel cyclone combustors, one operating fuel rich and the other operating with excess air; and (4) suspension gasification by the hot exhaust gases from the MHD duct with ash removed prior to combustion. Option 1 has the highest ash content in the combustion plasma and as a result would have the greatest operational difficulties associated with it. Options 2 and 4 have the cleanest MHD combustion plasma. For coal priced at $4/ton, the power generating cost of Option 4, 11.78 mills/kW-hr, is the highest, with Option 1, at 9.04 mills/kW-hr the lowest. These costs may be compared with a conventional power cost of 9.92 mills/kW-hr for the late seventies. Capital costs of three of the four options were competitive with those of conventional thermal power plants employing stack gas SO_2 cleanup systems. Option 2 has the most favorable combination of operating characteristics and power cost. It was concluded that a clean, high-temperature working fluid can probably be produced from coal without leading to depressed system efficiencies and exorbitant capital costs. (auth)

9637 IS PIPELINE GAS FROM CATTLE MANURE A VIABLE FUEL? Elec. Light Power, E/G Ed.; 51: No. 23, 31-33(Dec 1973).

A process used in which hydrogen was reacted with cow manure to determine the distribution and yield of hydrogasification products was evaluated. It was concluded that, for reasonably large plants, the gas would be cheaper than any other fuel source except natural gas at present prices. Manure and hydrogen are fed into a hydrogasification reactor, with an operating pressure about 1,000 psig because high pressure favors methane production, lowers the gas purification investment, and reduces the cost of compressor equipment to discharge the gas into the pipeline. The process is exothermic and any heat in excess of that required by the process can be used for steam production. Energy for the plant steam requirements is realized from the burning of char produced in the hydrogasifier. The cow manure was selected as a logical feedstock because of its chemical suitability and feedlots containing upwards of 50,000 head of cattle sanctioned reasonable-sized gas-production plants to be built nearby, eliminating transportation fees. (MCW)

9638 CAN EMISSIONS FROM COAL-FIRED BOILERS BE MONITORED EFFECTIVELY? Elec. Light Power, E/G Ed.; 51: No. 23, 28-29(Dec 1973).

Southern Services evaluated 19 individual analyzers and seven sample conditioning units for continuous stack sampling applica-

tions on power plants for sulfur dioxide, nitrous oxides, and visible emissions. The program included all major analytical techniques such as infrared, ultraviolet, electrochemical, chemiluminescence, and flame photometric. The scope of the program, the results of wet chemical analysis, and the performance of the sample conditioning package were discussed. (MCW)

9639 GILBERT PROPOSES SHORT LEAD-TIME COAL-FUELED COMBINED CYCLE. Elec. Light Power, E/G Ed.; 51: No. 23, 26-27(Dec 1973).

The design of a 150-Mw commercial coalgas-powered combined-cycle plant is proposed. Inputs to the Gilbert gasifier are preheated air and powdered coal, sized to 5 mm X O. The air, entering through a grate at the bottom, will produce a fluidized bed, avoiding the caking problem of fixed-bed gasifiers. A small portion of the coal's carbon will be oxidized to CO, supplying enough heat to drive off the volatiles. The resultant fuel gas will have a heat value of about 250 BTU per cubic foot. The gas fuels the gas turbine part of the plant, after passing through the gasifier-air preheater, a cleanup system, and a compressor. The system is proportioned so that the gas turbine generates 30 percent of the total power. The gasifier converts only a small part of the coal to fuel gas, with char remaining that contains almost all the ash from the original coal and one-half the sulfur. The char is sent to the Ignifluid boiler to fuel the steam side of the cycle. Following the boiler are a feedwater economizer section, a low-pressure boiler, and a conventional steam turbine-generator system. The complexity of removing sulfur is a drawback, and the biggest advantage is that it will operate with high-ash coal, including fuel recovered from waste piles or waste of present mining operations. (MCW)

Information Handling

9640 (JUL-961-RG) ANALYSIS AND IMPROVEMENT OF THE INTERNAL FLOW OF SCIENTIFIC INFORMATION WITHIN A SUBJECT FIELD OF THE NUCLEAR RESEARCH FACILITIES AT JUELICH. Mueller-Frank, U. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorentwicklung). Jun 1973. 143p. (In German). Dep. NTIS (U. S. Sales Only) $9.25.

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

The dissemination of information does not ideally take place by itself, even in a relatively small controllable circle of people. The controlling of an internal flow of information is mostly coincidental. In the present work, an information distribution system is introduced to help this communication. By evaluation of the cycling of the system in the form of answers from the system's user on mediated information, the personal view can be confirmed and expanded. (GE)

9641 (ORNL-4913) AEC/RECON PROJECT AT ORNL. Gove, N. B.; Brooks, A. A.; Culkowski, A. H.; Hammons, C. E.; Haeuslein, G. K.; Malthouse, W. B.; Plemens, R. E.; Pomerance, H. S.; Taylor, D. G. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 97p. Dep. NTIS $5.45.

The present status of the AEC/RECON project is discussed, with particular reference to the ORNL participation. A little of the history of the project is given, plus some technical description and a user's manual. AEC/RECON is an information retrieval project that uses CRT screens for rapid display of results from computerized files. Bibliographic data from Nuclear Science Abstracts and other data bases are available for searching. The project came to ORNL in 1971 with 5 terminals and 150,000 bibliographic entries. Now there are 15 terminals and 300,000 entries. (auth)

9642 MODULAR ELECTRONIC SYSTEMS FOR NUCLEAR RESEARCH. Parry, J. K. (Australian Atomic Energy Commission, Lucas Heights). Aust. Phys.; 10: No. 9, 146-150(Sep 1973).

Modular electronic systems are reviewed, and in particular the NIM and CAMAC systems are described. (RL)

Law

9643 APPLICATION TO URANIUM COMPOUNDS OF THE VALUATION REDUCTION ON IMPORTED PRODUCTS ACCORDING TO PARAGRAPH 80 OF EStDV. Mayer-Wegelin, E. (Deutsche Gold- und Silber-Scheideanstalt, Frankfurt am Main). Atomwirt., Atomtech.; 18: No. 8-9, 419-420(1973). (In German).

According to paragraph 80 of the EStDV, a valuation reduction is permitted for certain imported products, which are liable to considerable price variations on the world market. This valuation reduction has the effect of delaying the respective taxes as long as the favored commodities are actually in stock. This also applies to U_3O_8, UF_4, and UO_2 powder, but not to sintered UO_2 pellets. The imported goods reduction is also valid for a second buyer. (GE)

Management

9644 (EUR-5060) ANNUAL REPORT, 1972. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center). Oct 1973. 460p. Dep. NTIS (U.S. Sales Only) $25.00. EUR B.Fr. 550,-.

The program set up by the Council of Ministers is reviewed. For each of the actions or objectives, the allocated budget and manpower situations are presented. The organization of the establishment is discussed. A summary of the results in the various programs includes information on the fast breeder reactor, reactor safety, information analysis, ECO reactor, ESSOR reactor, HTGC reactor, safeguards, physics of condensed matter, SORA reactor, nuclear materials, applied information, standards and certified reference materials, and protection of the environment. The divisions reporting progress in research include CETIS, Nuclear Studies, Physics, Technology, Electronics, Materials, Petten, Chemistry, and Biology. The operation of the big installations of the ISPRA-I reactor, ECO reactor, ESSOR plant, and the computing center and their supporting activities are summarized. (MCW)

9645 (HMI-B-133) ANNUAL REPORT, 1972. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H (F. R. Germany)). Jun 1973. 174p. (In German). Dep. NTIS (U. S. Sales Only) $10.75.

Included are reports on general institutions (organizational structure, administration, library, etc.), research and development (radiochemical field, nuclear chemistry, reactor, data processing/electronics), and the scientific technical infrastructure equipment. A complete publication list according to subject is given. (GE)

9646 NUCLEAR RESEARCH AND DEVELOPMENT PROGRAM FOR ITALY. Clenentel, E. (CNEN, Rome). Nucl. Eng. Int.; 18: No. 209, 777-779(Oct 1973).

In a review of the plans for nuclear research and development in Italy, the functions and aims of the National Committee for Nuclear Energy, CNEN, whose 5-year plan for 1973 to 1977 was recently approved, are discussed. Financial commitments are considered in some detail, including expenditure from research facilities, reactors, fuel cycles, and safety. Figures are quoted for the distribution of personnel in the various fields of activity. (UK)

Mathematics and Computers

Refer also to abstracts 7911, 7938, 7951, 8105, 8107–8109, 8111, 8112, 8114–8117, and 8120–8130.

9647 (ANCR-1119) IBM 360/FR-80 ONLINE COMPUTER OUTPUT MICROFILM SYSTEM. Speas, D. H.; Smith, A. J. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Oct 1973. Contract AT(10-1)-1375. 86p. Dep. NTIS $5.45.

A description is given of an online method developed and used by Aerojet Nuclear Company to transmit command streams generated on the IBM 360/75 to the FR-80 Microfilm System. This method provides for the automatic generation of microfilm output from the transmitted data. Instructions are given for the computer user to obtain computer output on microfilm through the system. Detailed instruction is given for system operators from setup procedures to error recovery. (auth)

9648 (KFK-PDV-2) EVALUATION OF LITERATURE CONCERNING DIAGNOSIS OF COMPUTER SYSTEMS. Stimmelmayr, R. (Kernforschungszentrum Karlsruhe (F. R. Germany)). May 1973. 23p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

The basic reports or studies of previous activities and results achieved regarding the subject of diagnostics computers were selected from a variety of papers and are collected in the appendix. The common structure of the various methods and the possible modifications are demonstrated in a concise form. (51 references) (auth)

9649 (LA-5426-MS) METHOD FOR INCREASED ACCURACY IN EULERIAN FLUID DYNAMICS CALCULATIONS. Rivard, W. C.; Farmer, O. A.; Butler, T. D.; O'Rourke, P. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 18p. Dep. NTIS $4.00.

A method for increased accuracy in Eulerian fluid dynamics calculations is described. The essence of the method is local cancellation of low-order, diffusional truncation errors. These errors are the source of nonlinear numerical instabilities. The methodology is described in general and specific application is made to the transient, two-dimensional flow equations for chemi-

cally reacting mixtures. Two example problems are solved to illustrate the method. For comparison, the same problems are solved with an artificial viscosity technique. (auth)

9650 (RISO-283) COMPUTER PROGRAMS FOR TEXTURE SIMULATION. Leffers, T. (Danish Atomic Energy Commission, Risoe. Research Establishment). Mar 1973. 85p. Dep. NTIS (U. S. Sales Only) $6.25.

A description is given of three computer programs (ROLTEX 2, ROLTEX 1, and HORS dOEUVRE) for the simulation of the plastic deformation in face-centered-cubic polycrystals and the derived development of rolling texture. The description includes a variety of test examples demonstrating that the programs work correctly. Results produced by the programs and the physical interpretation of these results are not presented. (auth)

9651 (RL-73-126) MNEMONIC: AN INTERACTIVE GRAPHICS PROGRAM TO GENERATE A TRIANGULAR MESH FOR TRIM. Newman, M. J. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). Feb 1972. 19p. (RHEL/R-238). Dep. NTIS (U. S. Sales Only) $3.00.

Lack of any easily available graphical display has been a severe limitation in the use of TRIM, the two dimensional magnetostatic program in batch use at the Rutherford Laboratory. Data preparation for TRIM for any non-trivial geometry is a lengthy task. There are many possibilities for errors. Interpretation of error diagnostics without graphics facilities is a tedious and inefficient process. Using batch processing, many days can be spent in removing errors from a complex set of data. MNEMONIC allows TRIM users to test their boundary data using a graphics display terminal. It allows them to correct any errors interactively, and to generate a triangular mesh as required by TRIM. The resultant mesh can also be inspected and edited if necessary. The mesh data, and a full set of data for TRIM, can be stored on disk datasets for subsequent access by TRIM in the batch. Thus, a corrected set of data can be created in one short on-line session. The users can also avoid time wasting and expensive calculations with data that contains errors which TRIM has not detected. (auth)

9652 (RT/EDP-(73)2) INTERACTIVE COMPUTER GRAPHICS METHOD FOR THE STUDY OF THE MOTION OF MECHANICAL LINKAGES. Dal Bono, I.; Ricci, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 28 May 1973. 25p. Dep. NTIS (U.S. Sales Only) $3.25.

An application of interactive computer graphics to the simulation and design of plane mechanical linkages is illustrated. CDP, a graphic extension of CSMP, is used as a basis for the oriented system LKG by means of which the linkage geometry and parameters can be interactively modified, its real motion visualized, and the locus generated by any linkage points displayed. (auth)

9653 (SLA-73-752) ULTRAFAST EVALUATION OF EXPONENTIAL-TRIG SERIES FOR REPETITIVE CALCULATIONS. Zuppero, A. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 13p. Dep. NTIS $3.00.

A computing scheme that allows repetitive calculations of an exponential-decay Fourier series using only four multiply and four addition operations per trig function frequency is presented. The function evaluated is the general form for very common computer problems. (auth)

9654 PAST, PRESENT, AND FUTURE OF MINICOMPUTERS: A SCENARIO. Koudela, J. Jr. (Varian Data Machines, Palo Alto, CA). Proc. IEEE (Inst. Elec. Electron. Eng.); 61: No. 11, 1526-1534(Nov 1973).

This article traces the evolution of minicomputers from 1955 to 1973 and forecasts their near-future characteristics and uses. Advances significant in the growth of minicomputers are tutorially described as they occurred in nineteen different machines. Only computers having attained the status "commercially available" are included. The entire discussion is based on two descriptors: the first, depicting the content and use of minicomputer systems (hardware, software, applications, and tradeoffs); and the second, outlining the size and type of systems (simple, complex, general-purpose, and special-purpose). Future minicomputers will continue to diversify in the four general directions indicated by the size-type descriptor. By superimposing the user desires for easier programming, better performance, and lower cost onto the size-type descriptor, the article concludes with a description of future systems. (auth)

Miscellaneous

9655 (ANCR-1126) SHORT- AND LONG-RANGE POTENTIAL FUNCTIONS FOR VALENCE-BONDED CRYSTALS USING VALENCE SYMMETRY COORDINATES. McMurry, H. L. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Sep 1973. Contract AT(10-1)-1375. 39p. Dep. NTIS $4.00.

The theory is given for deriving symmetry coordinates suited to calculating correct normal modes as well as vibration frequencies in crystals. In addition, the coordinates should be well suited to expressing force constants in terms of the energy changes accompanying distortion of the ground-state electron configuration. The coordinates are chosen as symmetrical displacement patterns of the atoms in a primitive cell and adjacent cells. They can be chosen to emphasize stretching of bonds or deformations of interbond angles and, therefore, to take account of valence bonding in the crystal. The long-range-force interactions arising from vibrationally induced dipoles are conveniently expressed. To illustrate the method an application to diamond is developed. (auth)

9656 (AREAEE-164) PREPARATION OF CALCIUM FLUORIDE, MAGNESIA, ALUMINA, AND SPINEL REFRACTORIES. Haroun, N. A.; Orabi, G. I. (Atomic Energy Establishment, Cairo (Egypt)). 1973. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Slip casting of crucibles and cylinders of CaF_2, MgO, Al_2O_3, and spinel was investigated and optimum conditions were determined. (DLC)

9657 (BDX-613-559) RUST PREVENTION IN TOOL STORAGE AREAS. Bandler, S. W. (Bendix Corp., Kansas City, Mo. (USA)). Jan 1972. Contract AT(29-1)-613. 20p. Dep. NTIS $3.00.

Several commercial water-displacing, rust-inhibiting fluids were evaluated for effectiveness in preventing formation of rust on tools and equipment in an electronic assembly tool crib. Since these fluids must be removed to prevent contamination of the products on which they are used, cleaning methods also were investigated. The atmosphere in the tool crib was monitored for a sufficient time to reflect the effects of outdoor temperature and relative-humidity changes, and was tested for contaminating elements which promote the formation of rust on ferrous metals. Two of the fluids, LPS-2 and Permatex DLF, were effective in preventing rust under the conditions investigated. No wholly satisfactory cleaning method was established. (auth)

9658 (BDX-613-951) PRESSURE DISTRIBUTION IN POLYCARBONATE INJECTION MOLDINGS. Black, P. C. (Bendix Corp., Kansas City, Mo. (USA)). Oct 1973. Contract AT(29-1)-613. 52p. Dep. NTIS $4.75.

A 33-treatment injection-molding study was performed as an extension of earlier pressure transducer work reported in BDX-613-601. The recent study dealt with four variables (Cavity thickness, injection pressure, mold temperature, and melt temperature) and their effects on internal Cavity pressure distribution of a thermoplastic molding. A significant change in Cavity pressure response occurred when the mold Cavity thickness was reduced to approximately 0.080 inch (2.03 mm). The internal Cavity pressure distribution was nearly identical for the same combinations of injection pressure, mold temperature, and melt temperature when the Cavity thickness was 0.0960 and 0.2605 inch (2.438 and 6.617 mm). Injection pressure was highly significant in the prediction of internal Cavity pressure for all Cavities tested. Melt temperature was highly significant for the thinnest Cavity (0.0650 inch) (1.651 mm). Mold temperature, over the range tested, was not significant in altering measured internal Cavity pressure for any of the mold inserts. (10 tables, 22 figures) (auth)

9659 (BDX-613-955) ALUMINUM ETCHANT CONTROL STUDY. Knopf, W. H. (Bendix Corp., Kansas City, Mo. (USA)). Aug 1973. Contract AT(29-1)-613. 12p. Dep. NTIS $3.00.

Studies of ferric chloride–phosphoric acid–water solutions used for etching precision patterns in aluminum foil resulted in reliable analysis procedures for detecting solution depletions. Replenishment of the etchant on a regular basis using specified guidelines has been shown to increase its effective life and produce more consistent quality than previous attempts at solution control. (auth)

9660 (BDX-613-991) METHOD OF INSPECTING DIELECTRIC MATERIALS AT MICROWAVE FREQUENCIES. O'Dell, G. D. (Bendix Corp., Kansas City, Mo. (USA)). Nov 1973. Contract AT(29-1)-613. 25p. Dep. NTIS $3.25.

A successful method of screening high-dielectric-constant, nonmagnetic, high-loss-factor materials at microwave frequencies was developed to provide material control by incoming inspection. This is accomplished by measuring the S parameters of the material — reliance on the manufacturer's permittivity data and x-ray examination for voids and inclusions is no longer necessary. Use of an automatic network analyzer makes 100% inspection economically feasible. (auth)

9661 (BDX-613-1002) INVESTIGATION OF INTERNAL CAVITY PRESSURE AND THICKNESS RESPONSE FOR INJEC-

TION-MOLDED POLYCARBONATES. Black, P. C. (Bendix Corp., Kansas City, Mo. (USA)). Nov 1973. Contract AT(29-1)-613. 35p. Dep. NTIS $3.75.

The internal cavity pressure of an injection mold was evaluated as a controlling variable for the thickness of typical polycarbonate moldings. Mold temperature, melt temperature, and mold-fill mode were evaluated for their effects on molding thickness and thickness runout, designated as the total indicator reading. (TIR). (auth)

9662 (BNWL-SA-4794) TOLERANCE OF SELECTED FISH SPECIES TO ATMOSPHERIC GAS SUPERSATURATION. Fickeisen, D. H.; Montgomery, J. C.; Schneider, M. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1973. Contract AT(45-1)-1830. 5p. (CONF-730963-1). Dep. NTIS $3.00.

Several fish species were collected in SE Washington, acclimated to 20°C and 100 to 150% gas supersaturation, and exposed to high-gas-content waters (100 to 140% supersaturation) at 20°C under standard acute bioassay conditions. The fish were monitored to determine death time and necropsied to determine the cause of death. The species exhibited a differential tolerance to high gas levels with smallmouth bass more tolerant and salmonids less tolerant. Nearly all fish that died during the test exhibited signs of gas bubble disease, ranging from massive heart embolism to mild subepidermal emphysema. These signs were related to exposure time and to gas supersaturation levels. Gas concentrations were monitored by molecular sieve gas chromatography. (auth)

9663 (BNWL-tr-102) SOLID-STATE INTERACTION BETWEEN ALKALINE OXIDE M_2O (M = Na, Li) AND THE OXIDE OF CHROMIUM III. Lavielle, L.; Kessler, H.; Hatterer, A. Translated by E. R. Appleby from Bull. Soc. Chim. Fr.; No. 6, 1919-1921(1973). 11p. Dep. NTIS $3.00.

Na_2O and Cr_2O_3 mixtures heated to 450°C form $NaCrO_2$ and Na_4CrO_4. $Li_2O-Cr_2O_3$ mixtures form only $LiCrO_2$. (DLC)

9664 (CEA-CONF-2367) TRANSBRONCHIC PASSAGE OF METALLIC PARTICLES. Masse, R.; Ducousso, R.; Nolibe, D.; Lafuma, J.; Chretien, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). 1973. 2p. (In French). (CONF-730570-1). Dep. NTIS (U. S. Sales Only) $3.00.

From Congress on alveolar macrophage; Lille, France (28 May 1973).

9665 (CEA-N-1559(2)) EXACT MODELS IN STATISTICAL MECHANICS: THE BETHE METHOD AND ITS GENERALIZATIONS. Gaudin, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). Aug 1973. 164p. (In French). Dep. NTIS (U. S. Sales Only) $10.25.

Bethe's method and its generalizations, algebraic methods derived by Baxter for diagonalizing the transfer matrix of the eight vertex model in a zero field, and the general problem of identical particles interacting via a delta potential in one dimension are covered. Some of the techniques of Yang and Sutherland are not very different from those used for the inhomogeneous case of the six vertex system. The limiting case of the previous problem leads to an interesting representation of the permutation group and furnishes a way to diagonalize a class of quadratic spin Hamiltonians. (auth)

9666 (CEA-R-4500) CALCULATION OF BINDING ENERGIES IN DEFECT CLUSTERS. Dang Dinh Cung. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). Nov 1973. 23p. (In French). Dep. NTIS (U. S. Sales Only $3.25.

9667 (CEA-R-4512) PRACTICAL METHOD GIVING A QUANTITATIVE ESTIMATE OF OCEANIC POLLUTION. Doury, A.; Badie, C. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92 – Montrouge (France)). Nov 1973. 23p. (In French). Dep NTIS (U. S. Sales Only) $3.25.

As a logical followup to a preceding report treating similar questions for the atmosphere, a simple method is presented for calculating oceanic pollution. The method consists essentially of a Gaussian solution to a diffusion equation, the variable coefficients of which have been obtained by experiment. As is the case for air, the originality of the method resides, principally, in never forgetting that the importance of diffusion effects depends on their duration and that the Gaussian solution is more and more near to the physical reality of the problem with increasing smallness of the extent of its validity in space and time. It is for this reason that the instantaneous point-emission model was chosen as the elementary formulation. It is, in fact, this elementary formulation which gives the model its flexibility by permitting the practical resolution of all types of problems likely to occur with a minimum reasonable amount of calculation facilities (point and extended sources, instantaneous and continuous sources, transient regimes, complex current carriers). The method is always open to improvement as the numerical value of the parameters can be modified with the increased experimental experience acquired. The extension to a number of problems concerning the pollution of freshwater (lakes, water courses) should not present major problems. (auth)

9668 (CEA-R-4517) DESIGN AND REALIZATION OF ROTATING MACHINES SUBMERGED IN CRYOGENIC FLUID. Application to a Liquid Hydrogen Pump. Rival, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France)). Nov 1973. 161p. (In French). Dep. NTIS (U. S. Sales Only) $10.25.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

The basic elements for a rotating machine submerged in cryogenic fluid were studied. The bearing rolling elements are the angular contact type and have bonze-filled Teflon separators. The electric motor is 3-phase, asynchronous, squirrel-cage. The output power is 500 W at 300°K and 1200 W at 20°K. For these temperatures the iron losses increase for 20%, but the efficiency reaches 90%. A pump may be built with these specifications. The characteristics are given for liquid hydrogen. Other materials may be used in a closed loop or a transfer line. (tr-auth)

9669 (CONF-7210107-1) QUANTUM THEORY OF SUPERRADIANCE IN SPONTANEOUS EMISSION FROM ATOMIC SYSTEMS WITH DIPOLAR COUPLING. De Martini, F. (Rome Univ. (Italy). Istituto di Fisica). 2 Feb 1973. 33p. Dep. NTIS (U.S. Sales Only) $3.75.

From 1st Taormina research conference on the structure of matter polaritons; Sicily, Italy (2 Feb 1973).

9670 (CONF-7210107-2) NONLINEAR OPTICS OF BULK POLARITONS. De Martini, F. (Rome Univ. (Italy). Istituto di Fisica). 20 Feb 1973. 46p. Dep. NTIS (U.S. Sales Only) $4.50.

From 1st Taormina research conference on the structure of matter polaritons; Sicily, Italy (2 Feb 1973).

9671 (COO-623-195) SOME COMMENTS ON MANGANIN WIRE PRESSURE GAGES. Andeen, C.; Schuele, D.; Fontanella, J. (Case Western Reserve Univ., Cleveland, Ohio (USA); United States Naval Academy, Annapolis, Md.). 1973. 9p. Dep. NTIS $3.00.

A standard manganin wire pressure gage was examined by comparing it with a recently developed 0.01% CaF_2 capacitive pressure gage. The effects of the Bridgman "water kick" and intrinsic time constant are clearly shown, and the results punctuate the usual assertion that manganin wire gages are extremely difficult to use approaching the 0.1% level. (auth)

9672 (COO-623-198) LOW-FREQUENCY DIELECTRIC CONSTANTS OF α-QUARTZ, SAPPHIRE, MgF_2, AND MgO. Fontanella, J.; Andeen, C.; Schuele, D. (United States Naval Academy, Annapolis, Md.; Case Western Reserve Univ., Cleveland, Ohio (USA)). 1973. 18p. Dep. NTIS $3.00.

The 1000 Hz, 300°K dielectric constants were measured for crystalline α-quartz, sapphire, MgF_2, and MgO, and polycrystalline sapphire (Lucalox), magnesium fluoride (IRTRAN 1), and magnesium oxide (IRTRAN 5). The measurements were performed using the method of substitution (two-fluid method). Results are: single-crystal α-quartz, $\epsilon_{s||} = 4.6368 \pm 0.001$, $\epsilon_{s\perp} = 4.5208 \pm 0.001$; single-crystal sapphire, $\epsilon_{s||} = 11.589 \pm 0.005$, $\epsilon_{s\perp} = 9.395 \pm 0.005$; polycrystalline sapphire (Lucalox), $\epsilon_s = 10.154 \pm 0.007$; single-crystal MgF_2, $\epsilon_{s||} = 4.826 \pm 0.01$, $\epsilon_{s\perp} = 5.501 \pm 0.01$; polycrystalline MgF_2 (IRTRAN 1), $\epsilon_s = 5.289 \pm 0.001$; single-crystal MgO, $\epsilon_s = 9.830 \pm 0.001$; and polycrystalline MgO (IRTRAN 5), $\epsilon_s = 9.833 \pm 0.01$, where $\epsilon_{s||}$ and $\epsilon_{s\perp}$ are the dielectric constants parallel and perpendicular, respectively, to the c-axis. (auth)

9673 (COO-1198-1027) CONDUCTION-ELECTRON SPIN DENSITY AROUND Fe IMPURITIES IN Cu ABOVE AND BELOW T_K. Boyce, J. B.; Slichter, C. P. (Illinois Univ., Urbana (USA)). 1973. Contract AT(11-1)-1198. 12p. Dep. NTIS $3.00.

The nuclear resonances of five shells of Cu atoms that are near neighbors to single Fe atoms in dilute alloys of CuFe were observed. The resonance positions show that the conduction-electron spin polarization oscillates with distance from the Fe impurity. Four of the resonances from 300°K to well below the 29°K Kondo temperature were followed finding that, for all four, the spin density has the same temperature dependence as the magnetic susceptibility. These data show that, contrary to some speculation, there is no drastic change in the spatial polarization associated with the "Kondo condensation." (auth)

9674 (COO-1332-86) ECOLOGY OF DUCK BROODS IN A FORESTED REGION OF NORTH-CENTRAL MINNESOTA. Ball, I. J. Jr. (Minnesota Univ., Minneapolis (USA)). Dec 1973. Contract AT(11-1)-1332. 80p. Dep. NTIS $6.00.

Thesis.

During the summers of 1968-1972, 45 mallard (Anas platyrhynchos) and 26 wood duck (Aix sponsa) females with broods were radio tracked on the rivers, lakes, and small wetlands of a forested region of north-central Minnesota. The resulting 3729 radio locations were analyzed with respect to movements and habitat use. Supplementary information was also gathered on food availability and on duckling mortality. (LMT)

9675 (COO-2081-8) EFFECTS OF NONADIABATIC TRANSITIONS ON INVARIANTS OF THE MOTION. Aamodt, R. E.; Jaeger, E. F. (Colorado Univ., Boulder (USA). Dept. of Astro-Geophysics; National Center for Atmospheric Research, Boulder, Colo. (USA)). May 1973. Contract AT(11-1)-2081. 19p. Dep. NTIS $3.00.

A computer study is made of the change in adiabatic invariant for a plane pendulum when a slow variation in the pendulum length forces the pendulum to change from a uniformly rotating motion to an oscillating state. The numerical results are shown to be in good agreement with a simply derived analytic expression which itself is generalizable to calculations of nonadiabatic transitions in other problems. (auth)

9676 (COO-2223-1) SPIN-LABELED MEMBRANES. Progress Report, November 1, 1972–September 1973. Keith, A. D. (Pennsylvania State Univ., University Park (USA). Dept. of Biophysics). Sep 1973. 7p. Dep. NTIS $3.00.

The development of unsaturated fatty acid auxotrophs as subjects for spin label studies and as a measure of getting information about biological membranes was investigated using Neurospora crassa. (HLW)

9677 (COO-3292-7) BEHAVIOR OF PHOSPHATE IN THE INTERSTITIAL WATERS OF CHESAPEAKE BAY SEDIMENTS. Bray, J. T. (Johns Hopkins Univ., Baltimore, Md. (USA)). 1973. 167p. Dep. NTIS $10.50.

Thesis.

Determinations of dissolved inorganic phosphate concentrations and a number of related chemical parameters were made on interstitial water from Chesapeake Bay sediments. The activities of dissolved phosphate and ferrous iron are covariant and are shown to be described satisfactorily by an equilibrium model involving the mineral vivianite $Fe_3(PO_4)_2 \cdot 8H_2O$. The presence of sedimentary vivianite, which lends support to the equilibrium model, is demonstrated by X-ray diffraction techniques. Interstitial water of Chesapeake Bay sediments contain large quantities of dissolved inorganic phosphate. Estimates of the diffusional flux of phosphate, however, indicate that the release of phosphate from the sediments may have little effect on the overlying water. Oxidation during sampling procedures is shown to decrease the inorganic phosphate concentrations in interstitial water rich in ferrous iron. All sampling and analytical procedures must be carried out in an inert atmosphere. (auth)

9678 (COO-3400-22) CALCIUM KINETICS IN COWS. Third 3-Year Progress Report, December 23, 1969–May 22, 1973. Ramberg, C. F. Jr.; Kronfeld, D. S.; Mayer, G. P. (Pennsylvania Univ., Philadelphia (USA)). 1973. Contract AT(11-1)-3400. 10p. Dep. NTIS $3.00.

The scope of the research program included the effects of dietary calcium intake on calcium kinetics and plasma parathyroid hormone in general and on the relation between the rates of calcium absorption and calcium removal from bone in particular. (ERB)

9679 (COO-3400-23) CALCIUM KINETICS IN COWS. Ninth Annual Progress Report, May 23, 1972–May 22, 1973. Ramberg, C. F. Jr.; Kronfeld, D. S.; Mayer, G. P. (Pennsylvania Univ., Philadelphia (USA)). 1973. Contract AT(11-1)-3400. 9p. Dep. NTIS $3.00.

The scope of the research program included: the relation between age, calcium kinetics, and parathyroid hormone; regulation of calcium absorption; effects of dietary calcium on plasma calcium responses to prolonged intravenous calcium infusion; and the effects of dietary magnesium and phosphorus on calcium kinetics. (ERB)

9680 (COO-3531-2) TECHNICAL PROGRESS REPORT OF BIOLOGICAL RESEARCH ON THE VOLCANIC ISLAND SURTSEY AND ENVIRONMENT FOR THE YEAR 1972. Fridriksson, S. (Surtsey Research Society, Reykjavik (Iceland)). [nd]. Contract AT(11-1)-3521. 99p. Dep. NTIS $7.00.

Studies were conducted on dispersal, colonization, and ecological succession of terrestrial plants and animals. Species lists are presented of vascular plants, mosses, lichens, and birds. (HLW)

9681 (DP-MS-73-48) CYCLOOCTATETRAENYL NEODYMIUM(III) BROMIDE AND CYCLOOCTATETRAENYL NEODYMIUM(III) IODIDE. Karraker, D. G.; Palm, M. P. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1973. Contract AT(07-2)-1. 10p. (CONF-731113-2). Dep. NTIS $3.00.

From American Chemical Society 25th annual southeastern regional meeting; Charleston, South Carolina, USA (7 Nov 1973).

Synthesis and magnetic susceptibility measurements on Nd(COT)I · xTHF and Nd(COT)Br · xTHF (THF = tetrahydrofuran and x = 3 or 4) are presented. (DLC)

9682 (JINR-E4-7274) K-MATRICES AND T-MATRICES FOR FINITE SYSTEMS OF GENERAL MUFFIN-TIN POTENTIALS. Ziesche, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

General muffin-tin potentials, defined to be nonzero within arbitrary volumes and zero outside, and their scattering states, asymptotically described by generalized phase shifts and partial wave amplitudes, are considered. The K and T matrices on the energy shell are expressed by these asymptotic quantities. For a cluster of general muffin-tin potentials, the enveloping spheres of which may overlap, the K and T matrices on the energy shell and their eigenstates are derived and discussed. (auth)

9683 (JINR-E4-7415) MULTIPLE SCATTERING WITHIN FINITE AND INFINITE SYSTEMS OF GENERALIZED MUFFIN-TIN POTENTIALS. Generalizations of the Cluster Equations, the Lloyd-Formula, and the KKR Equations. Ziesche, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 24p. Dep. NTIS (U. S. Sales Only) $3.25.

9684 (JINR-P2-7435) ENERGY-MOMENTUM TENSOR FOR LIQUID. Strel'tsov, V. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Based on the analysis of the transformation formulas for the components of the energy-momentum tensor for ideal liquid it was shown that the requirement on the normal pressure invariance could hardly be considered acceptable, since, then, e.g., in the reference system, where this liquid is moving, the flux of transferred energy (S_x) turns out to be equal to zero. It is pointed out also that the use of the conventional definition (vector) of the moving volume leads to the liquid at rest having a momentum differing from zero. The latter difficulty is overcome by another definition of the volume, applied previously to the case of the electromagnetic field of the classical electron. (auth)

9685 (JINR-P4-7397) PHASE STATES OF HEMATITE IN MAGNETIC FIELD. Nitts, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 8p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Symmetry of the hematite phase states and other substances of a similar structure in the external magnetic field at different temperatures is considered on the basis of phenomenological theory of weak Dzyaloshinskii ferromagnetism. Possible types of phase transitions between these states are considered. (auth)

9686 (JINR-P5-7258) REGULARIZATION OF THE ITERATION PROCESSES OF THE NEWTON TYPE. Aleksandrov, L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Computing Techniques and Automation). 1973. 28p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The general "additive–multiplicative" regularization of the Newton-type processes is considered in order to solve the nonlinear operator equations. Statements are presented on the convergence and existence of the iteration scheme, covering the main subclasses of the Newton-type R processes. Corollaries of these statements are given for the Schreger R processes (of the third order) and the Gauss-Newton R processes. (auth)

9687 (JUL-948-PP) INVESTIGATION OF THE DIELECTRONIC RECOMBINATION PROCESSES IN Ne IX, F VIII, AND O VIII IONS. Pospieszczyk, A. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Plasmaphysik). May 1973. 89p. (In German). Dep. NTIS (U. S. Sales Only) $6.50.

Thesis. Submitted to Bochum Univ. (West Germany).

As the dielectronic recombination processes at high temperatures can be best observed in the x-ray region, the weak x-ray spectra of neon, fluorine, and oxygen were investigated between 13 and 22 A by means of a Bragg spectrometer with a KAP crystal (2d = 26.62 A) on a linear theta pinch. By examining the intensity history and the resonance and satellite lines it was confirmed that, at least in the late discharging phase, the satellite lines are mainly due to ions that have dielectronically recombined. To determine the size and the behavior of the recombination coefficients, the behavior of the intensity ratio of resonance to satellite lines was examined, depending on electron temperature

and nuclear charge for the cases: $I(1s^2\ ^1S-1s2p^1P)/I(1s^2\ 2s\ ^2S-1s2s2p\ ^2P)$ and $I(1s^2\ ^1S-1s2p\ ^1P)/I(1s^2 2p\ ^2P-1s2p\ ^2D)$. These were compared with the theoretical, existing relationship for neon, fluorine, and oxygen. There is good agreement between theory and experiment for small main quantum numbers (n = 2), however, the beginning of a systematic deviation with fluorine shows that with neon (and indications with fluorine), there is no further thermal equilibrium of the auto-ionization states with the continuum. The Burgess calculated auto-ionization probabilities are too large. In the spectra, a number of lines not previously observed nor identified could be seen and partly classified. (GE)

9688 (KFK-1774) INVESTIGATION OF THE COLLECTIVE MOVEMENTS IN POLYCRYSTALLINE AND LIQUID COPPER BY INELASTIC NEUTRON SCATTERING. Hagen, S. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Sep 1973. 66p. (In German). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis. Submitted to Karlsruhe Univ. (West Germany).

9689 (LA-5435-MS) ROCK HEAT-LOSS SHAPE FACTORS FOR SUBTERRENE PENETRATORS. Cort, G. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1973. Contract W-7405-eng-36. 13p. Dep. NTIS $4.00.

Results of calculations to predict heat losses to surrounding rock for Subterrene rock-melting penetrators of various shapes are presented in nondimensional form that can be applied to a range of axisymmetric penetrator geometries. Theoretical upper and lower limits are placed on a dimensionless time parameter, which includes penetrator dimensions, rock properties, and penetration rate. At these limits, heat losses either approach zero or are unaffected by penetrator geometry and velocity. The estimated heat losses from the nondimensional parameters agree well with experimental data and numerically calculated results. (auth)

9690 (LBL-1863) ELECTRONIC STRUCTURE OF DIAMOND, ZINCBLENDE, AND CHALCOPYRITE SEMICONDUCTORS. de Alvarez, C. V. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 1973. Contract W-7405-eng-48. 147p. Dep. NTIS $9.50.

Thesis.

The dependence of energy band structure and electronic charge density on pseudopotential parameters is investigated for: InSb, InAs, InP, GaP, Si, $ZnGeP_2$, and $ZnGeAs_2$. (DLC)

9691 (LBL-1880) CURRENT DISTRIBUTION AND MASS TRANSFER IN ROTATING ELECTRODE SYSTEMS. Nisancioglu, K. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1973. Contract W-7405-eng-48. 235p. Dep. NTIS $13.75.

Thesis.

9692 (NP-19874) CHARACTER OF MOESSBAUER SPECTRA AND SOME STRUCTURAL PECULIARITIES OF NATURAL MONOCLINIC PYROXENES. Ekimov, S. P.; Krizhanskii, L. M.; Nikhitina, L. P.; Khristoforov, K. K. (Radievyj Inst., Leningrad (USSR)). 1973. 17p. (In Russian). (RI-6). Dep. NTIS (U. S. Sales Only) $3.00.

Moessbauer spectra of the natural clinopyroxenes of $CaMgSi_2O_6-CaFeSi_2O_9-NaFe^{3+}Si_2O_6$ composition are analyzed. (DLC)

9693 (NP-19889) FLATTENING OF OIL DROPLETS ON A GLASS PLATE. van Beukering, F. C.; van't Riet, A.; Ferron, G. A. (Interuniversitair Reactor Instituut, Delft (Netherlands)). Sep 1973. 8p. (In Dutch). Dep. NTIS (U. S. Sales Only) $3.00.

9694 (ORNL-EIS-73-60(Vol. 1)(No. 2)) NSF-RANN TRACE CONTAMINANTS ABSTRACTS. Copenhaver, E. D. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Aug 1973. Contract W-7405-eng-26. 63p. Dep. NTIS $5.25.

Fifty-six papers were presented at the First Annual National Science Foundation Trace Contaminants Conference held at Oak Ridge National Laboratory, August 8-10, 1973; fifty-four abstracts and two titles are included here. Emphasis is placed on problems involved in sampling and measurements of trace amounts of contaminants in ecological samples. A brief account of other Trace Contaminants news not related to the conference is included. (CH)

9695 (ORNL-EIS-73-60(Vol. 1)(No. 3)) NSF-RANN Trace Contaminants Abstracts. Copenhaver, E. D. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Oct 1973. Contract W-7405-eng-26. 45p. Dep. NTIS $4.25.

Fifty three abstracts are included in this edition of the publication on environmental contaminants. A brief statement on the status of the program and its personnel is included. (ERB)

9696 (ORNL-EIS-73-62) NSF-RANN TRACE CONTAMINANTS PROGRAM DIRECTORY. Copenhaver, E. D. (Oak Ridge National Lab., Tenn. (USA)). Aug 1973. Contract W-7405-eng-26. 73p. Dep. NTIS $5.75.

This directory is designed to aid effective communication throughout the National Science Foundation, Research Applied to National Needs Trace Contaminants Program. The majority of the participants in the Program are represented—by name, address, telephone number, and very brief description of research interest. Each research project is described more completely in Report of Awards 1971-1972, Division of Environmental Systems and Resources, Research Applied to National Needs, National Science Foundation (July 1972); and the research results are being abstracted in the new bi-monthly NSF-RANN Trace Contaminants Abstracts. The directory has three major divisions to facilitate its use. Section I contains listings of the program managers, the principal investigators, and the co-principal investigators and coordinators. Section II lists the personnel by individual projects; while Section III contains a complete alphabetic listing complete with keyword indexes. (LMT)

9697 (ORNL-TM-4100) FLUID DYNAMICS OF A SPHERICAL PARTICLE: TABULATION OF SETTLING VELOCITY, REYNOLDS NUMBER, DRAG COEFFICIENT, RELAXATION TIME, AND ACCELERATION-DISTANCE IN AIR AND WATER. Fish, B. R.; Wilkie, W. H. (Oak Ridge National Lab., Tenn. (USA)). Nov 1973. Contract W-7405-eng-26. 172p. Dep. NTIS $10.75.

Various fluid dynamical parameters are calculated for spherical particles falling freely in air and in water. Tabulations include settling velocity, drag coefficient, and Reynolds number for particles from 1 to 1000 microns in diameter and having a buoyancy-corrected density of 1 to 12 g/cm^3. (auth)

9698 (ORNL-TM-4236) WATER RESEARCH PROGRAM FINAL REPORT, MARCH 15, 1970 TO OCTOBER 31, 1972. Separations Processes. Minturn, R. E. (comp.). (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 415p. Dep. NTIS $22.75.

A summary article on separation by filtration is reprinted, and research is reported in the following areas: dynamic membranes, cast film membranes, concentration polarization, economic analysis; and enhanced heat transfer. (DHM)

9699 (ORNL-TM-4385) PROGRAM TO EVALUATE ASSOCIATED LEGENDRE POLYNOMIALS AND SPHERICAL HARMONICS. Larson, N. M. (Oak Ridge National Lab., Tenn. (USA)). Dec 1973. Contract W-7405-eng-26. 21p. Dep. NTIS $3.25.

Suitable equations were derived and a FORTRAN program developed to evaluate the spherical harmonic $Y_{lm}(\theta,\varphi)$ for all physical values of the parameters (l a positive integer, m an integer in the range $-l \leq m \leq l$, θ and φ real but otherwise unrestricted). (auth)

9700 (ORNL-tr-2749) SPECTROPHOTOMETRIC DETERMINATION OF Zn WITH 4-(2-PYRIDYLAZO) RESORCINOL. Kitano, M.; Ueda, J. Translated from Jap. Anal.; 19: 987-994 (1970). 15p.

4-(2-pyridylazo) resorcinol (PAR) reacts sharply with zinc to form a water soluble orange-red complex. This complex has constant absorbance at pH 9.2 to 10.6, and its maximum absorbance is at 493 mμ. It has very high sensitivity with a molar absorptivity of 8.3×10^4, and the complex obeys Beer's law up to 0.8 μg/ml. The composition of the complex is Zn:PAR = 1:2. The effect of 38 coexisting ions was investigated, and it was found that indium, bismuth, copper, mercury(II), cadmium, yttrium, manganese, cobalt, and nickel interfere; however, indium and manganese can be masked by the addition of sodium pyrophosphate, while bismuth and yttrium can be masked with sodium tartarate and sodium fluoride, respectively. It is possible to combine the procedure with an ion exchange separation to determine trace levels of zinc in the presence of large quantities of copper, manganese, cobalt, and nickel. (tr-auth)

9701 (ORO-1797-46) HYPERSENSITIVITY IN COMPLEXES OF Nd(III) AND Ho(III) WITH DIBASIC AND POLYBASIC LIGANDS. Fellows, R. L.; Choppin, G. R. (Florida State Univ., Tallahassee (USA). Dept. of Chemistry). 1973. 18p. Dep. NTIS $3.00.

The hypersensitive transitions, $^4I_{9/2} \rightarrow {}^4G_{5/2}$, $^2G_{7/2}$ [Nd(III)] and $^5I_8 \rightarrow {}^5G_6$, $^5F_1$ [Ho(III)] were studied for lanthanide complexes with dibasic and polybasic ligands as well as for some mixed ligand complexes in aqueous solution. For the dibasic ligands, a linear relation is observed between the oscillator strength of the hypersensitive transition and the sum of the ligand pK_a values. With ligands that contain both N and O coordination sites, the correlation holds only when the basicity of the O sites is considered. (auth)

9702 (ORO-3992-135) CONDITIONS FOR A PHASE TRANSITION FOR A CLASS OF HAMILTONIANS. Ananthakrishna, G.; Suger, J. E. (Texas Univ., Austin (USA). Center for Particle Theory). [nd]. Contract AT(40-1)-3992. 28p. (CPT-184).

Dep. NTIS $3.50.

A class of Hamiltonians is considered for a system of one localized spin-½ particle per lattice site with the total spin as a good quantum number. By applying the Yang-Lee theorem, one obtains a set of conditions in form of inequalities relating the subpartition function, which is the partition function defined by the subset of energies with a specific value of spin. If the equality in the conditions are satisfied, then the system undergoes a phase transition. These conditions are then applied to an infinite range interaction model to obtain $J/kT_c = 1$. As another application, the bounds on the spectrum of the Heisenberg Hamiltonian are estimated. (auth)

9703 (ORO-3992-142) ENTROPY INCREASE FOR CENTRE PRESERVING DYNAMICAL MAPPINGS. Ananthakrishna, G. (Texas Univ., Austin (USA). Center for Particle Theory). 1973. 25p. (CPT-48). Dep. NTIS $3.25.

It is shown that the entropy increases for the center preserving dynamical maps. A relation between a subset of dynamical maps and stochastic maps of probability vectors is established. The existence of dynamical maps for which the entropy decreases is pointed out. (auth)

9704 (RD/B/N-2423) FRAGMENTATION IN THERMAL EXPLOSIONS. Board, S. J.; Farmer, C. L.; Poole, D. H. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Oct 1972. 24p. (CFR/SWP/P-(72)81). Dep. NTIS (U.S. Sales Only) $3.25.

Experiments involving explosions between molten tin and water are described. Results indicate that thermal explosions usually involve several distinct interactions, and that each interaction forms a bubble containing some vapor whose collapse initiates the next interaction. Thus, a small disturbance can escalate by successive growth and collapse cycles into a large explosion. It is postulated that vapor collapse is the main cause of dispersion in many thermal explosions; during collapse, a high-speed liquid jet is formed which penetrates and disperses in the molten material. (auth)

9705 (RLO-2225-5-17) EVOLUTIONARY ADVANTAGE OF RECOMBINATION. Felsenstein, J. (Washington Univ., Seattle (USA). Dept. of Genetics). 1973. 40p. Dep. NTIS $4.00.

The controversy over the evolutionary advantage of recombination initially discovered by Fisher and by Muller is reviewed. Those authors whose models had finite populations found an advantage of recombination, and those whose models had infinite populations found none. The advantage of recombination is that it breaks down random-linkage disequilibrium generated by genetic drift. (22 references) (LMT)

9706 (RLO-2225-T-19-27) PROGRESS REPORT, JULY 1, 1972–JULY 1, 1973. Cleland, R. (Washington Univ., Seattle (USA). Dept. of Botany). 1973. Contract AT(45-1)-2225. 10p. Dep. NTIS $3.00.

Biochemical changes in plant cell walls that lead to cell elongation were investigated, with emphasis on the effects of pH and auxin. (CH)

9707 (RLO-2229-T-6-1) INSTALLATION AND OPERATION OF A TELEMETERED SEISMIC NETWORK ON THE ALASKA PENINSULA. (Alaska Univ., College (USA). Geophysical Inst.). Nov 1973. Contract AT(45-1)-2229. 7p. Dep. NTIS $3.00.

Four short-period seismic stations were installed on the eastern Aleutians and the Alaska Peninsula as part of a nine-station network that provides data to study the seismotectonics of this area. Three vhf telemeter links were installed in order to be able to record centrally with common timing of sufficient precision. (auth)

9708 (SLA-73-485) RELATION OF CARBON FIBER AXIAL THERMAL EXPANSIONS TO THEIR MICROSTRUCTURES. Butler, B. L.; Duliere, S. F. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 26p. Dep. NTIS $3.50.

An expression was derived which relates carbon fiber structures to their axial thermal expansions. The fiber structure was considered to be composed of undulating graphite ribbons arranged in a ropelike configuration. These ribbons were assumed to have characteristic wave properties—an amplitude and wavelength—the ratio of which (A/λ), was obtained from preferred orientation measurement by x-ray pole figure analysis. The fiber axial thermal expansion coefficient, α_f, was calculated from the characteristic A/λ and graphite single-crystal thermal expansion coefficients. The expansions calculated by this method were compared with experimental values and values calculated from the Bacon anisotropy factor. (auth)

9709 (SLA-73-775) MACHINE SHOP PRACTICES FOR OXIDE CERAMIC BISQUE MATERIALS. Guernsey, G. R. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 41p. Dep. NTIS $4.00.

Supersedes SC-DR-70-521.

Techniques developed by Sandia Laboratories, Albuquerque, to machine various oxide ceramic bisque materials by using standard machine shop equipment are discussed. (auth)

9710 (SLA-73-823) STUDIES ON DERMESTID BEETLE: MATERIALS INTERACTIONS. II. Tests for Survival With Insulating and Packaging Materials. Brannen, J. P.; Gennaro, A. L.; Salb, T. J.; Aday, B. J.; Woolfolk, C. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1973. Contract AT(29-1)-789. 38p. Dep. NTIS $4.00.

Samples of various packaging and electrical insulating materials were exposed to larvae of Anthrenus flavipes and Dermestes maculatus under conditions of controlled light, temperature, and relative humidity. Of the materials tested, the only population survival was on vulcanized curled hair by Anthrenus flavipes. Starvation and cannibalistic characteristics of the two species were analyzed. (auth)

9711 (SLA-73-831) PROJECTILE PENETRATION OF IN SITU ROCK. Patterson, W. J. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov. 1973. Contract AT(29-1)-789. 23p. Dep. NTIS $3.25.

Ninteen tests of air-delivered, large projectiles (8 to 10 in. dia, 500 to 1000 lb) penetrating in situ rock are reported. The rock targets are classified in terms of the strength of an intact sample and the physical discontinuities in the formations. An instrumentation system was developed for rigid-body deceleration-versus-time data during rock penetration. Although soil penetrators exhibited poor structural integrity in the tests, the inverse plug joint high-strength steel projectiles proved adequate. (DLC)

9712 (SLA-73-976) DEGENERACY FACTOR IN LASER TRANSITIONS WITH NONDEGENERATE HYPERFINE SPLITTING. Palmer, R. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). Oct 1973. Contract AT(29-1)-789. 11p. Dep. NTIS $3.00.

The laser gain equations are investigated in the case where the laser transition is split by the hyperfine interaction into a number of discrete transitions. If relaxation among the hyperfine levels is rapid, then only the strongest transition will lase. Only the upper and lower states directly involved in the transition should be considered in the gain equations. (auth)

9713 (UCB-34-PA-142-2) STUDIES OF MEMBRANE STRUCTURE BY FREEZE-ETCHING. Progress Report. Branton, D. (California Univ., Berkeley (USA). Dept. of Botany). 23 Oct 1973. Contract AT(04-3)-34. 5p. Dep. NTIS $3.00.

The structure and organization of biological membranes was studied using a variety of physical and biochemical techniques together with electron microscopy and freeze etching. These studies provided knowledge relating the architecture of cellular membranes to their role in regulating the transport of molecules into and out of cells. A number of model systems, including Acholeplasma laidlawii membranes, were probed. The role of lipids and phase transitions in membrane structure and permeability was analyzed by lipid supplementation and temperature-shift experiments. Isolation techniques designed to separate membrane fragments into morphologically homogeneous preparations enriched for smooth or particulate regions are being devised, and the composition, permeability, and enzymatic activity of the resultant preparations will be compared. (auth)

9714 (UCID-16405) DISPERSIVE TEMPORAL COMPRESSION OF LASER PULSES AS AN ALTERNATIVE SOLUTION TO THE SELF-FOCUSING PROBLEM IN LASER AMPLIFIER CHAINS. Fisher, R. A.; Bischel, W. K. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Nov 1973. Contract W-7405-eng-48. 39p. Dep. NTIS $4.00.

In response to the discovery of a nonlinear index of refraction (n_2) in Nd : glass laser media, experimenters have traditionally expanded the beam diameter (and reduced the intensity) to alleviate the self-focusing tendency. It is proposed here to reduce the peak intensity by injecting a lower intensity and longer-duration pulse into the amplifier chain. It is predicted that the glass nonlinearity will impress upon the pulse a chirp suitable for efficient temporal compression. This may result in more efficient laser operation. Related schemes have been used in radar systems. As an example, the evolution of a 1 nsec (full 1/e duration) temporally Gaussian pulse in a 2 m long Nd : glass laser chain was calculated. For a chain averaged intensity of 2 GW/cm^2, one calculates that the pulse could be subsequently compressed (by a series of Gires-Tournois interferometers) to 125 psec with good stability against input pulse amplitude noise. (auth)

9715 (UCRL-74846) COMPUTER ANALYSIS OF THE FAN DOUBLET ANTENNA. Landt, J. A.; Deadrick, F. J.; Miller,

E. K.; Kirchofer, R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Oct 1973. 24p. (CONF-730935-3). Dep. NTIS $3.25.

From EMP technical meeting; Kirtland AFB, New Mexico, USA (25 Sep 1973).

The EMP response of the fan doublet, an hf–vhf communications antenna that resembles a bow tie viewed from broadside, was measured using a biconic simulator that produces a peak field strength at the antenna of 5600 V/m. Computations for comparison with the experimental data were performed, modeling the antenna with an integral equation approach in the frequency domain and Fourier transforming the data to the time domain to determine the transient response of the antenna. Results were obtained for the antenna located in free space and over a finitely conducting ground plane, the latter employing a modified image approach based upon the Fresnel plane wave reflection coefficients to model the antenna–ground interaction. The effect of the ground-reflected field is demonstrated. Effects of various load conditions are investigated using a time-domain integral equation approach. (auth)

9716 (UCRL-74908) BASIC-LANGUAGE EIGENVALUE ROUTINE. Morrison, I. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 24 Jul 1973. 18p. Dep. NTIS $3.00.

A program for calculating the eigenvalues and eigenvectors of a real symmetric matrix is described. (JFP)

9717 (UCRL-75113) CHARACTERIZATION OF SURFACES AND INTERFACES. Khan, J. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 28 Sep 1973. 20p. (CONF-730845-2). Dep. NTIS $3.00.

From surfaces and interfaces of glass and ceramics symposium; Alfred, New York, USA (27 Aug 1973).

A brief review is undertaken of surface characterization probes (e.g., electrons, ions, and photons) and the associated observables (e.g., electrons, ions/atoms, and photons). For a given probe, emphasis is placed upon the wide variety of phenomena that occur. These may add new dimensions of observations that may be made or suggest possible detrimental effects in either the measurements or on the surfaces of the specimen. Where they exist, commercially available tools or techniques are included. The caution is noted that where surface-analysis tools become more sensitive to the conditions at the surface, they also become sensitive to contaminating effects that may have their origin in sample preparation, handling, or the operation of analysis. (auth)

9718 (UCRL-Trans-1502) PROBABLE MECHANISMS OF THE DECOMPOSITION OF MARTENSITE. Bagaryatskii, Yu. A. Translated from Dokl. Akad. Nauk SSSR; 73: 1161-1164(1950). 13p. Dep. NTIS $3.00.

A correspondence between the structures of martensite and cementite is considered, and the mechanism of the rearrangement is relatively simple. Experimental determinations are examined and then the mechanism during low-temperature annealing can be represented as: (1) twinning of the martensite lattice along (121) planes by packets having a thickness $\frac{1}{2}$ I; (2) displacement of carbon atoms toward the twinning planes; and (3) the resultant warping of atomic planes. All these processes do not require any shift of Fe atoms exceeding the interatomic distance. It may be postulated that, after low-temperature annealing of steel, x-ray analysis of martensite single crystals should reveal effects of two-dimensional diffraction along directions of the type [112] and, possibly, one-dimensional diffraction along planes of the type (110) of the reciprocal martensite lattice. (MCW)

9719 TWO-COLOR FLUORESCENCE SENSOR (10 Oct 1973) (ENGINEERING MATERIALS). (Los Alamos Scientific Lab., N. Mex. (USA)). (CAPE-2372).

21 drawings.

A new flow system for quantitative analysis and sorting of small particles, particularly biological cells has been developed. Multiparameter analysis is made of fluorescent stained cells as they flow in a liquid suspension through a unique flow chamber. Electrical and electro-optical sensors measure cell volume, single or two-color fluorescence, and light scatter to determine cell discrimination. A laser beam is used to excite cell fluorescence and light scatter. Sorting is accomplished by breaking up the emerging stream into uniform droplets and sorting those conforming to preselected standards as determined by the processed signals. The drawings are of the two-color fluorescence sensor unit and of the electronics necessary to the operation of this system which include: (1) Model 8107 Coulter Amplifier and Constant Current Generator: (2) Model 8103 Amplifier; (3) Model 8102 Pulse Integrator; (4) Model 71 Multiparameter Signal Processing Unit; and (5) Model 72 Cell Separation Logic and Charging Control. A detailed description of this system has been published in the September 1973 issue of "Review of Scientific Instruments." (auth)

9720 DESIGN FEATURES OF SECONDARY REFRIGERANT FREEZING PLANTS. Burton, W. R.; Lloyd, A. I. (Atomic Energy Research Establishment, Harwell, Eng.). (1973). vp.

From 4th international symposium on fresh water from the sea and information report; Heidelberg, Germany (9 Sep 1973).

The development of Secondary Refrigerant Freezing Plants (SRF) in the United Kingdom has reached a stage where the process has been adequately demonstrated on sizes up to 45 m^3/day and detailed estimates of commercial plant costs shown to be attractive. The paper outlines the approach to meet the stringent design requirements encountered on an actual site in the UK and examines in detail the design considerations of the primary and secondary compressors. Additionally two other aspects, safety and environment, affecting component specifications are discussed. (GE)

9721 AUTOMATIC PROGRAMMER FOR AN ELECTRON BEAM WELDER (ENGINEERING MATERIALS). (Oak Ridge Y-12 Plant, Tenn. (USA)). (CAPE-2373).

36 drawings.

By interfacing a medium-sized computer with a 6-kw electron-beam welder, a system has been developed which permits automatic programming of weld parameters for single and multipass welds. The system programs focus current, high voltage, beam current enable, beam current value, beam current slope up/down, beam deflection enable, and data change point. The system software provides for storage of weld description files, editing of stored files, computer-assisted calibration and setup, and feedback of digital programming data during an automatic weld. By eliminating the necessity of stopping the machine after each pass and adjusting for the next, multipass welds are made much faster and with better weld consistency than was possible with the manual control method. (auth)

9722 CLASSICAL MECHANICS. Second Edition. Kibble, T. W. B. European Physics Series. New York; John Wiley and Sons, Inc. (1973). 264p. $13.50.

The discussion covers linear motion, energy and angular momentum, central conservative forces, rotating frames, potential theory, the two-body problem, many-body systems, rigid bodies and rotation about an axis, dynamics of a rigid body, Lagrangian mechanics, small oscillations and normal modes, and Hamiltonian mechanics. (JFP)

9723 CONSEQUENCES OF CONTROL OF AFRICAN TRYPANOSOMIASIS. Ford, J. (Oxford Univ.). pp 141-144 of Computer Models and Application of the Sterile-Male Technique. Vienna; International Atomic Energy Agency (1973).

From proceedings of computer models and application of the sterile-male technique; Vienna, Austria (13 Dec 1971). See STI/PUB-340; CONF-711230-.

COLLECTIONS OF USAEC REPORTS IN COUNTRIES OTHER THAN THE UNITED STATES

ARGENTINA
Buenos Aires, Comisión Nacional de Energía Atómica

AUSTRALIA
Canberra, National Library of Australia
Sutherland, New South Wales Atomic Energy Research Establishment

AUSTRIA
Vienna, Zentralbibliothek der Physikalischen Institute der Universität

BELGIUM
Mol-Donk, Centre d'Etude de l'Energie Nucléaire

BRAZIL
Rio de Janeiro, Comissão Nacional de Energia Nuclear
São Paulo, Instituto de Energia Atómica

CANADA
Chalk River, Ontario, Atomic Energy of Canada, Ltd.
Hamilton, Ontario, McMaster University
Ottawa, National Research Council

CONGO, REPUBLIC OF
Kinshasa, Trico Nuclear Center

DENMARK
Riso, Danish Atomic Energy Commission

FINLAND
Otaniemi, Teknillinen Korkeakoulu

FRANCE
Saclay, Gif-sur-Yvette, Centre d'Etudes Nucléaires de Saclay

GERMANY, WEST
Leopoldshafen, Zentralstelle für Atomkernenergie Dokumentation
Munich, Technische Universität

GREECE
Athens, Nuclear Research Center, Democritus Library

INDIA
Bombay, Trombay, Bhabha Atomic Research Center Library

IRAQ, REPUBLIC OF
Baghdad, Atomic Energy Commission, Nuclear Research Institute

IRELAND
Dublin, University College

ISRAEL
Yavne, Israel Atomic Energy Commission, Soreq Nuclear Research Centre

ITALY
Rome, Centro di Studi Nucleari della Casaccia

JAPAN
Tokyo, National Diet Library
Tokai-Mura, Naka-gun, Ibaraki-ken, Japan Atomic Energy Research Institute

KOREA, REPUBLIC OF
Seoul, Atomic Energy Research Institute

MEXICO
Mexico, D. F., Comisión Nacional de Energía Nuclear

NETHERLANDS, THE
Petten, Reactor Centrum Nederland
The Hague, Bibliothek Octrooiraad

NORWAY
Kjeller, Institutt for Atomenergi

PORTUGAL
Sacavem, Junta de Energia Nuclear

SOUTH AFRICA, REPUBLIC OF
Pretoria, Atomic Energy Board Library

SPAIN
Madrid, Junta de Energía Nuclear, Ciudad Universitaria

SWEDEN
Nyköping, Aktiebolaget Atomenergi Library

SWITZERLAND
Zürich, Swiss Federal Institute of Technology

UNITED KINGDOM
Harwell, Didcot, Berkshire, Atomic Energy Research Establishment
London, National Reference Library

IN INTERNATIONAL AGENCIES

EUROPEAN ATOMIC ENERGY COMMUNITY (EURATOM)
Brussels, Belgium
Ispra, Varese, Italy, Cetis Library

OECD NUCLEAR ENERGY AGENCY (NEA)
British Library Lending Division
Boston Spa, Wetherby, Yorkshire, England

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)
Vienna, Austria

GOVERN

PL

UNITED STATES
ATOMIC ENERGY COMMISSION
P. O. BOX 62
OAK RIDGE, TENNESSEE 37830

OFFICIAL BUSINESS

POSTAGE AND FEES PAID
U. S. ATOMIC ENERGY COMMISSION

FEES PAID
PRINTING OFFICE

XEROX UNIVERSITY MICROFILMS 1
SERIALS DEPT.
300 N. ZEEB ROAD
ANN ARBOR, MI 48106

AEC Critical Review Series

Available from
National Technical Information Service
U. S. Department of Commerce
Springfield, Virginia 22151

SOURCES OF TRITIUM AND ITS BEHAVIOR UPON RELEASE TO THE ENVIRONMENT (TID-24635), December 1968, **D. G. Jacobs,** Oak Ridge National Laboratory, $6.00.

REACTOR-NOISE ANALYSIS IN THE TIME DOMAIN (TID-24512), April 1969, **Nicola Pacilio,** Argonne National Laboratory and Comitato Nazionale per l'Energia Nucleare, $6.00.

PLUME RISE (TID-25075), November 1969, **G. A. Briggs,** Environmental Science Services Administration, $6.00.

ATMOSPHERIC TRANSPORT PROCESSES

Part 1: Energy Transfers and Transformations (TID-24868), December 1969, **Elmar R. Reiter,** Colorado State University, $6.00.

Part 2: Chemical Tracers (TID-25314), January 1971, **Elmar R. Reiter,** Colorado State University, $6.00.

Part 3: Hydrodynamic Tracers (TID-25731), May 1972, **Elmar R. Reiter,** Colorado State University, $3.00.

THE ANALYSIS OF ELEMENTAL BORON (TID-25190), November 1970, **Morris W. Lerner,** New Brunswick Laboratory, $3.00.

AERODYNAMIC CHARACTERISTICS OF ATMOSPHERIC BOUNDARY LAYERS (TID-25465), May 1971, **Erich J. Plate,** Argonne National Laboratory and Karlsruhe University, $3.00.

NUCLEAR-EXPLOSION SEISMOLOGY (TID-25572), September 1971, **Howard C. Rodean,** Lawrence Livermore Laboratory, $3.00.

BOILING CRISIS AND CRITICAL HEAT FLUX (TID-25887), August 1972, **L. S. Tong,** Westinghouse Electric Corporation, $3.00.

NEPTUNIUM-237 PRODUCTION AND RECOVERY (TID-25955), October 1972, **Wallace W. Schulz and Glen E. Benedict,** Atlantic Richfield Hanford Company, $3.00.